DEVO SEEREERAM, PH.D., P.E., LLC
CONSULTING GEOTECHNICAL ENGINEER
FLORIDA REGISTRATION NO. 48303

DEVO Engineering
CONSULTING GEOTECHNICAL ENGINEERS
5500 Alhambra Drive , Orlando, Florida 32808
Phone: (407) 290-2371 Fax: (407) 298-9011
E-Mail address: devo@devoeng.com
Website: http://www.devoeng.com

5500 Alhambra Drive ❄ Orlando, Florida 32808 ❄ Phone: 407-290-2371 ❄ Fax: 407-298-9011
e-mail: devo@devoeng.com | www.devoeng.com

Date: June 6, 2013	*Devo's Project No:* 13-610.53

To:
INWOOD CONSULTING ENGINEERS
3000 DOVERA DRIVE, SUITE 200
OVIEDO, FL 32765
Phone: 407-971-8850; Fax: 407-971-8955; email: ssommerfeldt@inwoodinc.com
attention: **STEVE SOMMERFELDT, P.E.**

Ref:
FLOOD MITIGATION JUSTIFICATION REPORT
ADDITIONAL & REPLACEMENT DRAINAGE WELL INSTALLATIONS
BIG SAND LAKE & LAKE SERENE, ORANGE COUNTY, FLORIDA

Dear Mr. Sommerfeldt:

Attached is our report for the above-captioned project. An executive summary is provided prior to the table of contents and it contains a concise overview of our findings and recommendations.

We trust that this report clearly explains the importance of installing additional drainage wells for the purpose of mitigating flood stages in Big Sand Lake. Please do not hesitate to contact the undersigned at (321)-229-8211 if there are any questions regarding this report.

Sincerely,

David H. Kincaid, P.G.
Florida Registration No. 1111
Date: June 6, 2013

Devo Seereeram

Devo Seereeram, Ph.D., P.E.
Florida Registration No. 48303
Date: June 6, 2013

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Phone: (407) 290-2371 • Fax: (407) 298-9011
E-Mail addresss: devo@devoeng.com
Website: http://www.devoeng.com

Date: July 17, 2013	*Devo's Project Number:* 13-610.53
to: **FLORIDA DEPT. OF ENVIRONMENTAL PROTECTION** 3319 Maguire Boulevard, Suite 232 Orlando, FL 32803-3767 attention: **CHRISTIANNE FERRARO, P.E.**	*cc:* **FLORIDA DEPT. OF ENVIRONMENTAL PROTECTION** 3319 Maguire Boulevard, Suite 232 Orlando, FL 32803-3767 phone: 407-897-4119 attention: **DUANE WATROBA**
cc: **ORANGE COUNTY PUBLIC WORKS DEPARTMENT** Roads and Drainage Division 4200 South John Young Parkway Orlando, FL 32839-9205 phone: 407-836-7875 fax: 407-836-7839 attention: **MARICELA TORRES, P.E.**	*cc:* **ORANGE COUNTY PUBLIC WORKS DEPARTMENT** Roads and Drainage Division 4200 South John Young Parkway Orlando, FL 32839-9205 phone: 407-836-7991 attention: **RODNEY J. LYNN, P.E.**
cc: **ORANGE COUNTY PUBLIC WORKS DEPARTMENT** Roads and Drainage Division 4200 South John Young Parkway Orlando, FL 32839-9205 phone: 407-836-7744 fax: 407-836-7839 attention: **LILIANA RAMIREZ, ENGINEER II**	*cc:* **INWOOD CONSULTING ENGINEERS** 3000 Dovera Drive, Suite 200 Oviedo, FL 32765 phone: 407-971-8850 Fax: 407-971-8955 attention: **STEVE SOMMERFELDT, P.E.**
Ref: **FLOOD MITIGATION JUSTIFICATION REPORT & PROPOSED ADDITIONAL DRAINAGE WELL INSTALLATIONS, BIG SAND LAKE & LAKE SERENE** **ORANGE COUNTY, FLORIDA**	

Dear Ms. Ferraro:

The attached report is a formalization of the oral presentation made to the FDEP on April 2, 2013. We would appreciate FDEP Staff review and consideration of the recommendations in this report for two (2) additional drainage wells on Big Sand Lake.

Please let us know if you need additional information or complete copies of the key referenced reports.

We trust that our evaluation and recommendations communicated in this report are clear and will be useful in your evaluation. If the proposed replacement is acceptable to the FDEP, we will prepare and submit detailed engineering plans and specifications for your review. Please do not hesitate to contact the undersigned if you have any questions.

Sincerely,

	
David H. Kincaid, P.G. Senior Hydrogeologist Florida Reg. No. 1111 Date: July 17, 2013	Devo Seereeram, Ph.D., P.E. Principal Engineer Florida Reg. No. 48303 Date: July 17, 2013

FLOOD MITIGATION JUSTIFICATION REPORT ADDITIONAL & REPLACEMENT DRAINAGE WELL INSTALLATIONS

BIG SAND LAKE & LAKE SERENE

ORANGE COUNTY, FLORIDA

Prepared by

DEVO Engineering
CONSULTING GEOTECHNICAL ENGINEERS

DEVO SEEREERAM, PH.D., P.E., LLC.
5500 ALHAMBRA DR., ORLANDO, FL-32808
PHONE: (407) 290-2371 - FAX: (407) 298-9011

Prepared for

Inwood Consulting Engineers

3000 Dovera Drive, Suite 200
Oviedo, FL 32765

DEVO SEEREERAM, PH.D., P.E., LLC
CONSULTING GEOTECHNICAL ENGINEER
FLORIDA REGISTRATION NO. 48303

Geotechnical Engineering • Ground Water Modeling • Hydrogeologic/Geo-Environmental Engineering

5500 Alhambra Drive ❄ Orlando, Florida 32808 ❄ Phone: 407-290-2371 ❄ Fax: 407-298-9011

e-mail: devo@devoeng.com | www.devoeng.com

Date: June 6, 2013	*Devo's Project No:* 13-610.53

To:

INWOOD CONSULTING ENGINEERS
3000 DOVERA DRIVE, SUITE 200
OVIEDO, FL 32765
Phone: 407-971-8850; Fax: 407-971-8955; email: ssommerfeldt@inwoodinc.com

attention: **STEVE SOMMERFELDT, P.E.**

Ref:

FLOOD MITIGATION JUSTIFICATION REPORT
ADDITIONAL & REPLACEMENT DRAINAGE WELL INSTALLATIONS
BIG SAND LAKE & LAKE SERENE, ORANGE COUNTY, FLORIDA

Dear Mr. Sommerfeldt:

Attached is our report for the above-captioned project. An executive summary is provided prior to the table of contents and it contains a concise overview of our findings and recommendations.

We trust that this report clearly explains the importance of installing additional drainage wells for the purpose of mitigating flood stages in Big Sand Lake. Please do not hesitate to contact the undersigned at (321)-229-8211 if there are any questions regarding this report.

Sincerely,

David H. Kincaid, P.G.
Florida Registration No. 1111
Date: June 6, 2013

Devo Seereeram

Devo Seereeram, Ph.D., P.E.
Florida Registration No. 48303
Date: June 6, 2013

EXECUTIVE SUMMARY

During calendar years 2003 to 2005, Big Sand Lake experienced prolonged periods of very high lake levels, such elevated water elevations not being reached since 1961-62 when Big Sand Lake was still recovering from its Hurricane Donna peak. Note that in the early 1960's the shoreline/watershed of Big Sand Lake was mainly undeveloped and very different from its present highly urbanized land cover. In fact, development within this basin accelerated only since the mid 1990's. These contemporary 2003-2004 high water encroachments were dramatic and alarming, causing property damage as well as instilling a flooding fear among the shoreline residents especially when the wave height was added to the peak stage. This water body has a significant fetch and hurricane strength winds can generate 2 to 3 ft high waves which aggravate the flooding and shoreline impacts. The high water levels in Big Sand Lake occurred during local wet seasons (i.e., June-September period) when there was more than 40 inches of rainfall (compared to a normal total of 26.5 inches).

Since Hurricane Donna in 1960, the Big Sand Lake watershed has transformed into highly urbanized land cover with residential and commercial developments, resulting in an increase in stormwater runoff volumes. Since that 2003-2005 high water event, the lake's discharge capacity through its only high-level outfall has been established at a maximum of 62 cfs by the agency regulating the receiving water body into which Big Sand Lake outfalls. Another major limitation is that permanent or temporary pumping permits are not readily granted since the South Florida Water Management District (SFWMD) is concerned about flooding in Shingle Creek (the receiving water course). There was significant residential flooding on Shingle Creek during the 2004 hurricanes which further heightens the concerns of the regulatory agency.

After the three (3) hurricanes of August-September 2004, the Florida Department Of Environmental Protection (FDEP) allowed the installation of one (1) 12-inch diameter drainage well in October 2004 to help mitigate the flooding. Based on recent conversations with FDEP staff (March 2013), they may be able to consider the installation of additional wells if sufficient "drainage-need" justification is provided. This preliminary study documents the drainage benefit of additional drainwell installations on Big Sand Lake.

The FDEP has indicated they will permit the addition of one (1) more well on Big Sand Lake as a replacement for the "lost" Lake Serene drainage well. However, our evaluation herein suggests that a total of four (4) 12-inch diameter drainage wells are required for effective lake level control, such a determination being primarily based on the observed performance of the similar-sized Lake Sherwood basin. Since the Lake Serene drainage well replacement has been approved, we recommend that the County pursue two (2) additional wells as part of their long-term plan for flood mitigation in this basin.

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1.0 Background Information

1.01 Location of Big Sand Lake & Limits of Its Watershed

Figure 1.1 (attached) is a 2013 color aerial photo of the area of interest in southwest Orange County (Fl) on the west side of Interstate Highway 4 (I-4) in the area of Sand Lake Road. It is recommended that the reader reviews this figure as a first step to gain a more incisive and visual understanding of the technical narrative in this report.

Big Sand Lake and its tributary lakes are labeled on Figure 1.1 with other annotations showing flow directions, basin boundaries, drainage wells, outfall pipes, and other key features which are described later in this report.

The limits of the 5,400± acre watershed of Big Sand Lake and its tributary lakes are shown on the 2013 color aerial map in Figure 1.1. Sub-watershed and lake interconnection links are also shown and these provide a quick understanding of the flow direction within the chain of lakes.

1.02 Progressive Urbanization within Big Sand Lake Watershed Since 1947

Historical aerial images of the Big Sand Lake watershed were available for several years dating back to as early as March 1947. These aerial photos are presented in Figures 2.1 through 2.12.

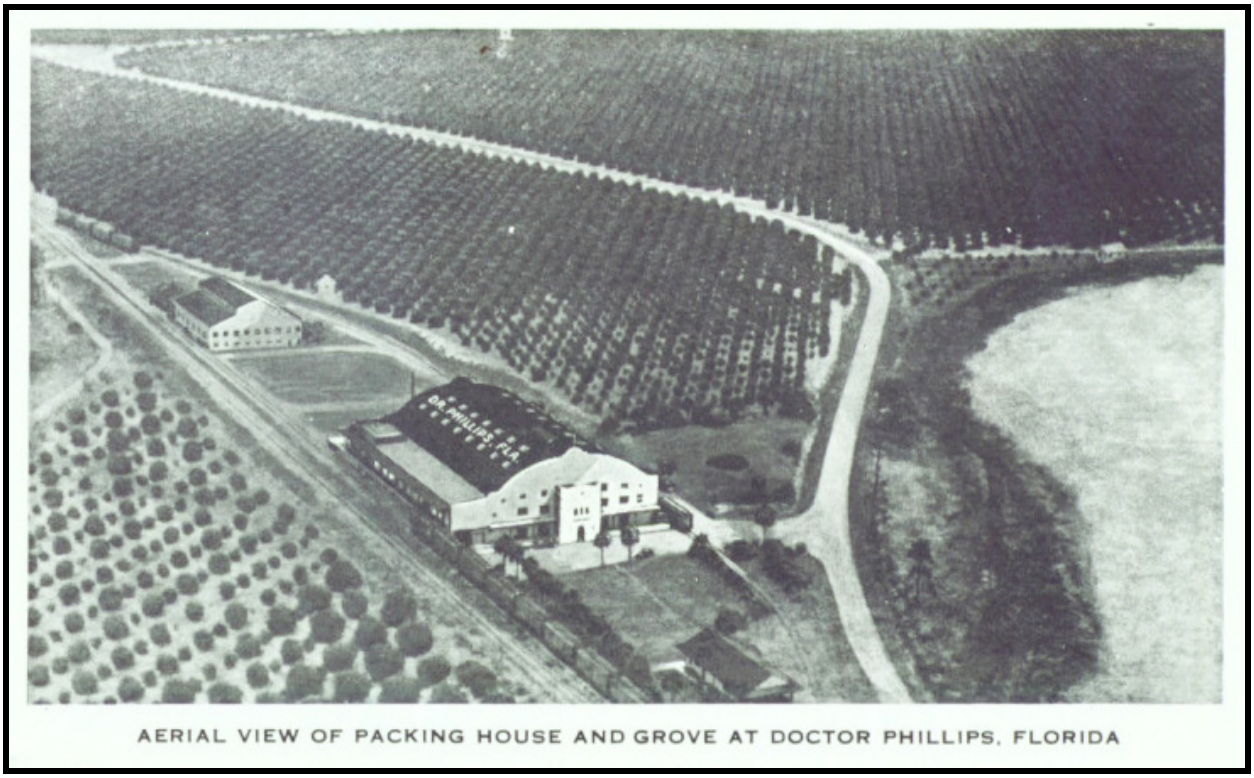

Photo 1. Aerial view of Dr. Phillips packing house on west side of Lake Serene (from postcard, date unknown)

Pertinent observations from review of these images are summarized in Table 1, mainly with a focus on highlighting changes in land use, development, and the addition of impervious areas.

Table 1. Review Comments on Historical Aerials

Figure/Year	Comments
Figure 2.1 - March 1947	The land areas around Big Sand Lake and its interconnected lakes were predominantly used for citrus groves except for the Dr. Phillips Packing house on the west side of Lake Serene. Extensive citrus groves are apparent along the entire northern and western portions of the basin. Apopka Vineland Road, Sand Lake Road and several other minor roads were present. There were no other signs of urbanization within the basin at the time of this photo. A high level, limited discharge capacity, outfall canal from the southernmost lobe of Big Sand Lake is apparent. This canal runs roughly southeast for about 2,000 ft and turns east and extends another 2,000 ft into Shingle Creek.
Figure 2.2 - March 1954	The land usage around the lakes remained relatively unchanged from 1947.
Figure 2.3 - Jan. 1957	The land usage around the lakes remained relatively unchanged from 1954; clearing for the I-4 corridor not yet started.
Figure 2.4 - 1962 (limited coverage)	I-4 corridor (under construction) present along the eastern side of Big Sand Lake. Land use around Big Sand Lake remained relatively unchanged without any increase in impervious area.
Figure 2.5 - 1963 (limited coverage)	Land use around Big Sand Lake remained relatively unchanged from 1962.
Figure 2.6 - Nov. 1969	Land use around Big Sand Lake remained relatively unchanged. Land use around the associated lakes remained relatively unchanged except that there was a small increase in development of the area on the northwestern side of Lake Serene (at the packing plant) and the southeastern side of Spring Lake. Citrus trees on the northern side of Lake Serene were sparse.
Figure 2.7 - Nov. 1974	Turkey Lake Road and ramp for S.R. 528 intersection with I-4 are visible along the eastern side of Big Sand Lake. Some development was present at the southeastern side of Big Sand Lake as well as the northwestern side. Land use in the other areas covered by the image remained relatively unchanged.
Figure 2.8 - Nov. 1978	There the area north of Wallace Road was cleared and roads and grading for residential subdivision was in progress. Several areas along the western side of Big Sand Lake and Apopka Vineland Road were cleared for development.

Table 1. Review Comments on Historical Aerials	
Figure/Year	**Comments**
Figure 2.9 - Feb. 1990	Subdivisions built out in the areas north of Wallace Road and west of Spring Lake, around Lake Boo Boo, south of Sand Lake Road and several areas west of the central portion of Big Sand Lake.
Figure 2.10 - April 1995	Major increases in residential subdivisions west of Big Sand Lake and some to the east.
Figure 2.11 - Jan. 1999	Significant increases in residential subdivisions west of Big Sand Lake continues.
Figure 2.12 - April 2002	Major increases in residential subdivisions west of Big Sand Lake continues. Developable areas almost built out.
Figure 1.1 - Jan 2013	There were some minor increases in development area within the basin since the 2002. There are however, some available, remnant strips of land, that have the potential to be developed. The entire watershed is developed except for these remaining uplands: 1. the uplands just east of Little Sand lake 2. Lake Boo Boo tract 3. area south of Big Sand Lake

These are key observations from review of the historical aerials:

- There was a progressive increase in developed areas within the basin from 1947. The extent of developed areas increased rapidly between 1995 and 2002, with the land being transformed from citrus mainly to residential subdivisions and commercial enterprises along the primary road corridors. Except for some remaining uplands, the lands with development potential within the watershed are virtually built out from inspection of the January 2013 aerial photo in Figure 1.1.

- There was major roadway development with the construction of the I-4 corridor (1957 to 1962) and then with SR 528 intersection and associated ramps (1973). The major roads within the basin were also widened, adding to the imperviousness of the watershed.

- The high level outfall canal from Big Sand Lake to Shingle Creek exists in 1947 but is modified during the construction of I-4.

1.03 Existing Discharge Facilities

The lake's surface water discharge facilities are of limited capacity and/or at a high elevation as described below:

❶ a single 12-inch diameter drainage well into the aquifer (installed October 2004 and location shown in Figure 1.1), and

❷ a high-level, limited discharge capacity surface water outfall to Shingle Creek via the C-1 Canal (also labeled in Figure 1.1), a conveyance system which is under the jurisdiction of the Valencia Water Control District (VWCD). Based on historical information in the VWCD files, the allowable maximum discharge into the C-1 Canal from Big Sand Lake's outfall is **62 cfs**. Calculations by Orange County confirm that this capacity corresponds to full pipe flow in the outfall system on Central Florida Parkway. Layout and elevation details of this outfall system are included in Attachment A.

1.04 Historical Drainage Wells

There are two (2) historical drainage wells on Big Sand Lake and its interconnected lakes which are classified as "lost" and they are listed below in Table 2 (see locations on Figure 1.1):

Table 2. Available Details of "Lost" Drainage Wells - Big Sand Lake & Lake Serene

Parameter	Unit	Lake Serene Drain Well	Big Sand Lake Drain Well
Status	-	"Lost"	"Lost"
Year Constructed	-	unknown	1931
Casing Diameter	inch	12	10
Casing Depth	ft	114	173
Total Depth	ft	356	484
Top Of Casing Elevation	ft NGVD	unknown	unknown
Lake Intake Elevation	ft NGVD	unknown	unknown
USGS ID	-	282636081300801	282514081290301
SFWMD I.D.	-	1494053494574	1485920500541

As explained in a later section of this report, the Big Sand Lake drainage well was replaced in 2004 under emergency conditions (although the original well could not be physically unearthed). However, the Lake Serene well was only been recently conceptually for replacement (see letter in Attachment B). FDEP conceptually approved the replacement of this well based on the strength of the USGS file documentation in Attachment B which verifies the historical existence of this well.

Magnified views of the general drain well locations are shown on the historical aerials in Figures 3.1 to 3.8 which cover the following years: 1947, 1954, 1957, 1962, 1963, 1969, 1974, and 1978. The exact physical well head cannot be clearly discerned on any of these aerial images.

1.05 Historical Lake Levels & Key Elevations

Exhibit 1 shows a chart of the historical water surface elevations (datum of "ft NGVD") in Big Sand Lake, with the following added visual reference lines/notes:

- Published 100 yr flood elevation for Big Sand Lake (+101.4 ft NGVD) and its apparent numerical derivation based on a 1 ft vertical shift above the Hurricane Donna stage (measured at +100.4 ft NGVD on Nov 1, 1960).

- Published normal water level of the lake (+90.0 ft NGVD).

- Control elevation of drainage well (+92 ft NGVD) installed in October 2004, but only fully gravity connected to the lake in September 2005.

- High water level event in Big Sand Lake due to excess cumulative rainfall coupled with a retaining wall failure (August 2003) in the Vizcaya development which resulted in Little Sand Lake coalescing and equalizing with Big Sand Lake (@ elevation +97.8 ft NGVD on Aug 29, 2003). Note that this was the first time Big Sand Lake's water level exceeded an elevation of +96 ft NGVD since March 1962 (more than 40 years previously when the basin was undeveloped). The monthly rainfall totals for the June-September wet season of 2003 at the Spring Lake rain gage are summarized in Table 3. Normal rainfall amounts are also shown for comparison.

Table 3. Monthly Rainfall For Wet Seasons of 2003 and 2004

Month	Rainfall Measured at Spring Lake (inch) **2003**	**2004**	Normal Rainfall Orlando Intl. Airport (inch)	Comments
June	9.01	5.00	7.35	
July	13.36	8.46	7.15	
August	14.26	16.66	6.25	Aug 9, 2003 wall failure
September	4.18	14.59	5.76	Sep 30, 2004 peak stage
Total	40.81	44.71	26.51	

- An even higher water level event (+98.38 ft NGVD) occurred following the three hurricanes of August-September 2004 which impacted this area. Note that this high water level was attained **before** the replacement drainage well was installed under emergency conditions in October 2004. The monthly rainfall totals for the wet season of 2004 are summarized in Table 3.

- The discharge elevation for the high level surface water outfall to the C-1 Canal (+96.3 ft NGVD).

- The 1981 drought water elevation +79.4 ft NGVD (December 1, 1981, same year as the Winter Park Sinkhole), which equates to a historic range of lake level fluctuation exceeding 20 ft (i.e., high of 100.4 ft NGVD & low of +79.4 ft NGVD).

- Exhibit 2 shows more details (via annotations) for the period 2003 to 2005 when the emergency pumping occurred. Annotations includes information with pump on/off dates and the timing of the replacement drainwell connection.

- Figure 4.1 shows the Orange County LIDAR land surface contours within the watershed. The contours are in ft NAVD and the NGVD-NAVD datum shift at this location is 0.883 ft, with NGVD being higher. The generalized high water impact zone on the shoreline of Big Sand Lake is shaded on this figure for visual reference. For the purpose of this report, this impact zone is defined from +90 ft NAVD (+90.9 ft NGVD) to +98 ft NAVD (+98.9 ft NGVD). The higher elevation is about 6 inches above the 2004 peak (to account for some minor wave action) and the lower level is about 1 ft above the published normal water level. The shading provides an indication of the sustained high water encroachment which can be expected when the summer cumulative rainfall totals approach or exceed 40 inches.

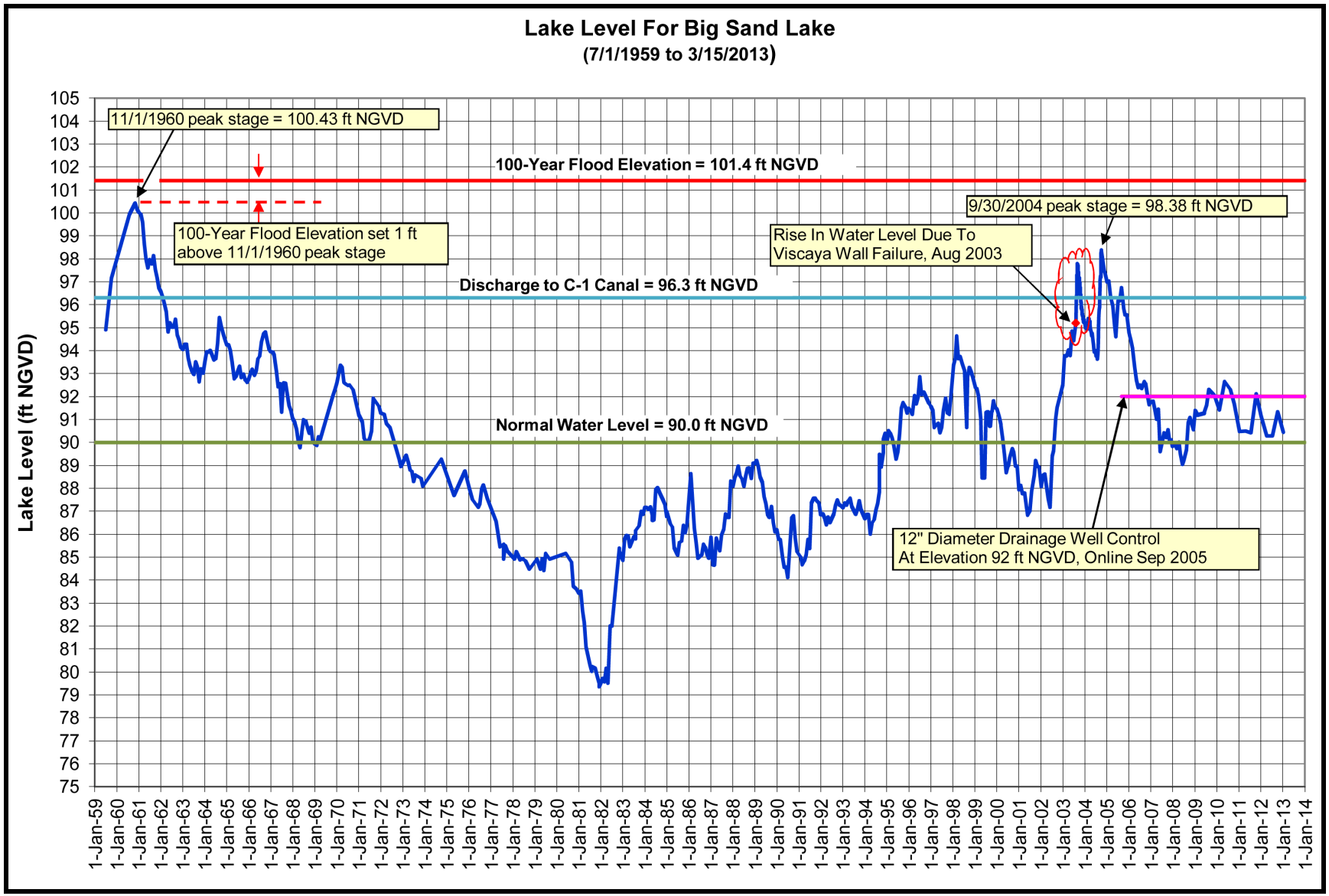

Exhibit 1. Lake Levels in Big Sand Lake and Key Elevations

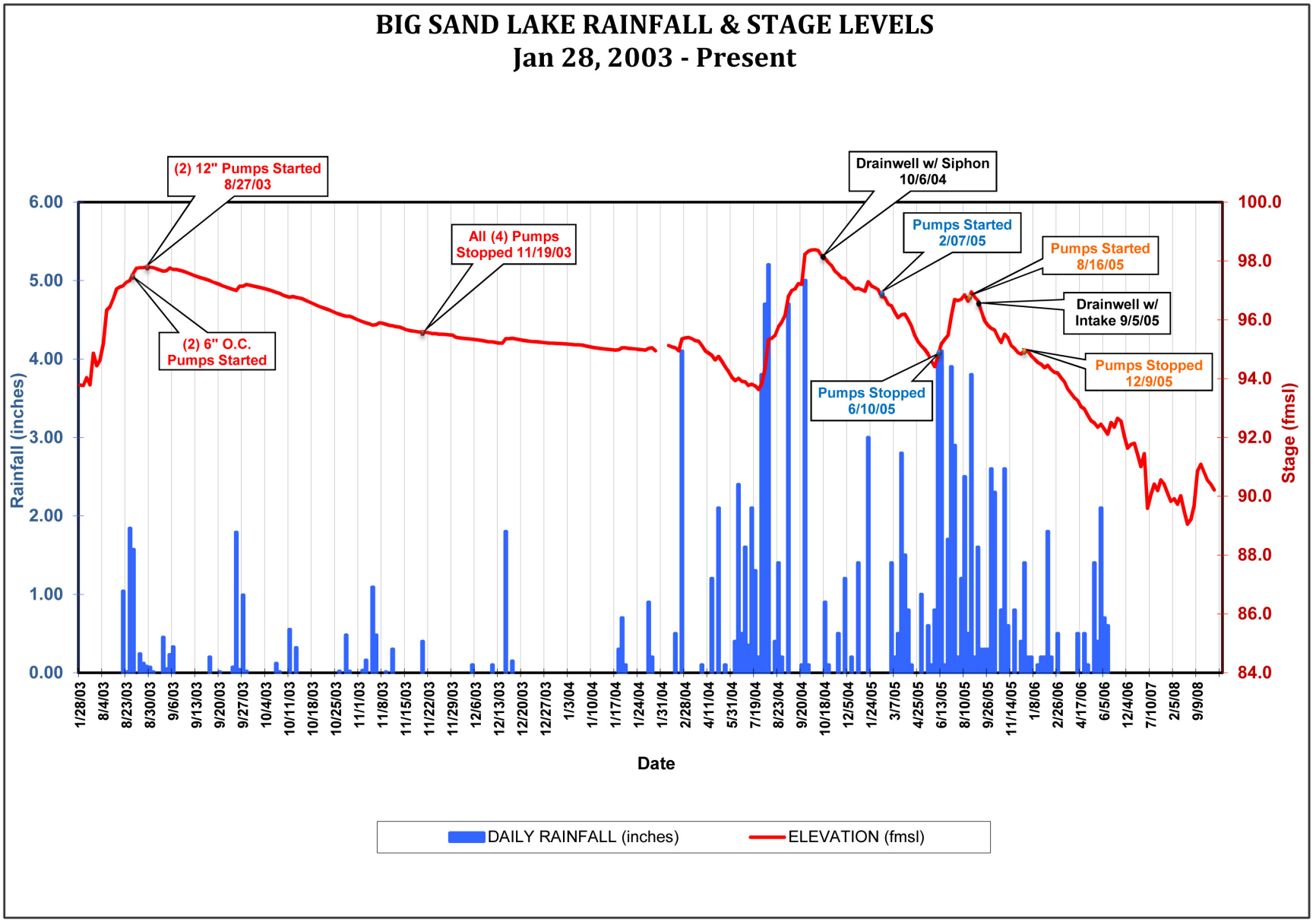

Exhibit 2. Pumping events for 2003 and 2005 (provided by Orange County)

1.06 High-Level Gravity Outfall System From Big Sand Lake to C-1 Canal

The outfall system from Big Sand Lake to the Valencia Water Control District (VWCD) C-1 Canal consists of a series of open channel segments and culverts sketched in Figure 1.1 but shown with details in Attachment A. The flow passes through the following culverts in sequence from west to east:

❶ 2 – 42 inch CMPS (access road adjacent to Big Sand Lake),

❷ 1 – 54 inch RCP and 1 – 48 inch RCP (under Turkey Lake Road),

❸ 2 - 48 inch RCP (under I-4 east bound entrance ramp),

❹ 1 – 6 foot by 4 foot CBC (under I-4),

❺ 2 – 48 inch RCP (under I-4 west bound exit ramp),

❻ 3 – 36 inch RCP (from small open channel to VWCD system),

❼ 1 –54 inch CMP (connection from 3 – 36 inch RCP to Central Florida Parkway collector system), and finally

❽ a series of 48 inch RCPs along the Central Florida Parkway through to the C-1 Canal.

Hydraulic analyses by Orange County indicates that the discharge rate is limited by the 48 inch diameter pipes on Central Florida Parkway with a calculated peak flow rate of 62 cfs. This magnitude is coincidentally the same as the maximum discharge rate allowed by VWCD into their C-1 Canal.

This high-level outfall means that Big Sand Lake is a closed basin until the water level reaches an elevation of +96.3 ft NGVD at the I-4 culvert.

1.07 August 9, 2003 Retaining Wall Failure

Some time over the weekend of August 9-10, 2003, there was a failure of the retaining wall in the Vizcaya condominium development. This retaining wall separates Little Sand Lake from Big Sand Lake and its location is noted in Figure 1.1 and is also shown in Photo 2.

Just prior to the wall failure, there was a 5.7 ft head difference across the lakes with the following recorded water elevations:

- Big Sand Lake = +95.2 ft NGVD (Aug 4, 2003), and
- Little Sand Lake = +100.9 ft NGVD (Aug 4, 2003).

After the wall failure, the water bodies coalesced resulting in a rapid rise of 2 ft in Big Sand Lake and an equalized elevation of approximately +97.2 ft NGVD (3.7 ft decline in Little Sand Lake). A collection of photos of this failure are compiled into Photo 3.

Orange County and the Big Sand Lake Advisory Board (BSLAB) sought and received an emergency pumping order from SFWMD to pump water from Big Sand Lake to C-1 Canal. The permit allowed the use of two (2) 6-inch diameter pumps and two (2) 12-inch diameter pumps to be active until November 19, 2003 (end of 90 day period). Pump on/pump off dates in calendar years 2003 and 2005 are shown in the chart in Exhibit 2.

At the same time, the accumulated sediment in the outfall system was cleaned out to allow water to flow out by gravity at elevation +96.35 ft NGVD.

During the 2003 emergency pumping from Big Sand Lake to the C-1 Canal, the channel banks in the C-1 Canal were scoured and collapsed just downstream of the Amil gate structures S-101 and S-102. Scouring occurred for a distance of approximately: ❶ 20 feet downstream of S-101, and ❷ 200 feet downstream of S-102.

Photo 2. Bird's Eye View of Connection Between Little Sand Lake and Big Sand Lake

Photo 3. Vizcaya Condo Retaining Wall Failure (August 2003; courtesy Orange County)

1.08 2004 Hurricanes & Lake Level Control Drainage Wells

Table 4 lists available details for the "lost" and "existing" drainage wells on Big Sand Lake; note that their locations are marked on Figure 1.1.

Table 4. Summary Of Drainage Well Characteristics

Parameter	Unit	Lake Serene Drain Well	Big Sand Lake Drain Well	Big Sand Lake Drain Well
Status	-	"Lost"	"Lost"	Existing
Year Constructed	-	unknown	1931	2004
Casing Diameter	inch	12	10	12
Casing Depth	ft	114	173	172
Total Depth	ft	356	484	383
Top Of Casing Elevation	ft NGVD	unknown	unknown	92
Lake Intake Elevation	ft NGVD	unknown	unknown	90.84
USGS ID	-	282636081300801	282514081290301	N/A
SFWMD I.D.	-	1494053494574	1485920500541	N/A

As noted in Exhibit 1, the lake level spiked to an elevation of +98.38 ft NGVD on September 30, 2004 following the three (3) hurricanes of August-September 2004 (refer to the rainfall data in Table 3). This high water event caused great alarm among the shoreline residents, more so since it came only a year after the August 2003 wall failure. Although the "lost" drainage wells could not be physically unearthed and be visually inspected, the FDEP allowed the emergency construction of a single replacement drainage well. A 12-inch diameter well was constructed at the location shown in Figure 1.1 with the construction details listed in Table 4; a bird's eye view of this present day well is in Photo 4.

Due to the very high lake levels at the time of construction, it was not possible to complete the drainage pipe connection from the well to the lake until September 5, 2005, although a siphon system was used to discharge into the well since October 4, 2004. These details are explained on the annotated chart in Exhibit 2. Significant pumping was also required to lower the lake level even after the siphon was set up as noted on this chart.

In addition to the drainage well construction, the outfall system to the C-1 canal was cleaned during this high water episode since the lake had not discharged through this system in over 40 years.

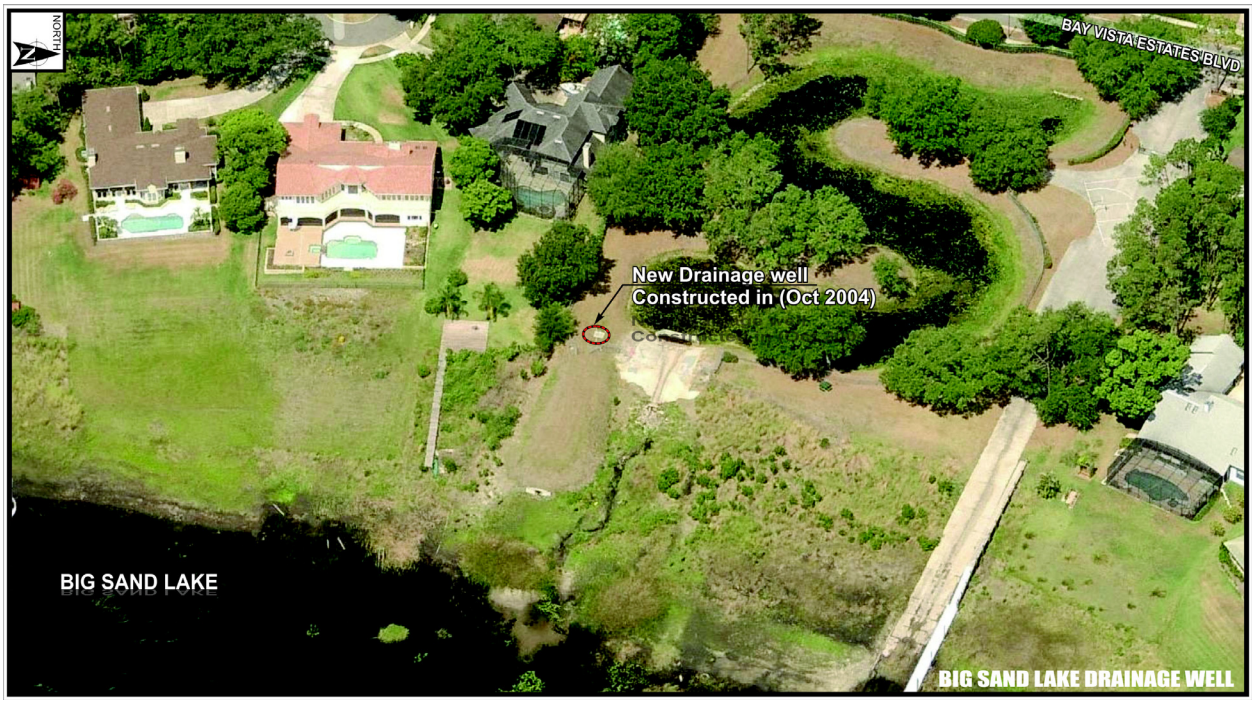

Photo 4. Bird's eye view of replacement drainage well constructed in October 2004

1.09 Lack of Influence of Underlying Floridan Aquifer

Big Sand Lake, unlike some lakes in the far southwestern corner of Orange County such as Lake Rexford and Lake Osage, is not very effectively connected to the underlying Floridan aquifer. Exhibit 3 shows the lake levels compared to the aquifer groundwater elevations and the head difference is generally more than 20 ft. Effectively connected lakes in Orange County are characterized by head differences of 5 ft or less. This means that the high water levels in the Big Sand Lake chain are not being caused by upwelling from the underlying deep limestone aquifer.

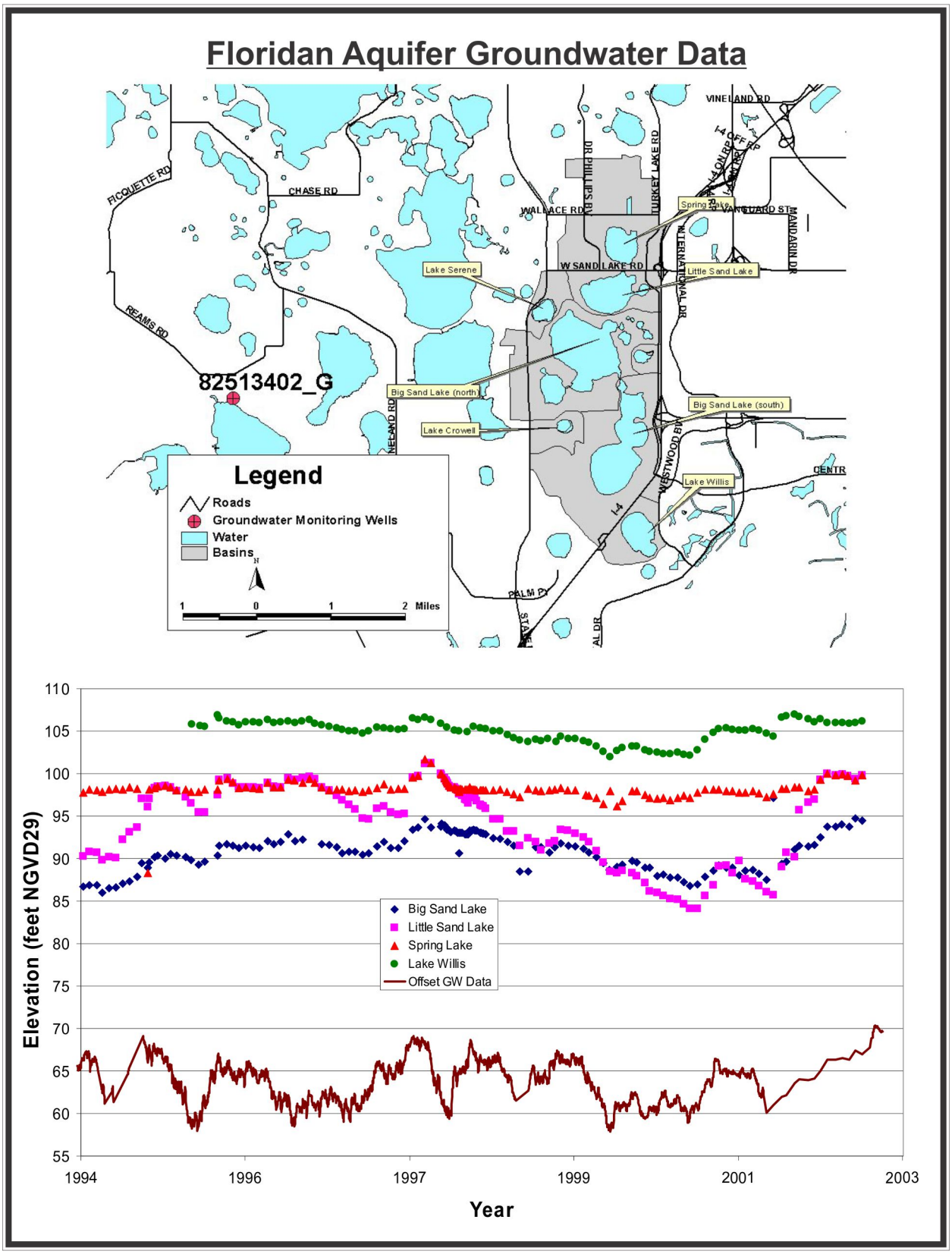

Exhibit 3. Floridan aquifer groundwater elevations compared to lake levels (CDM 2004)

1.10 2004 CDM Report

In January 2004 CDM issued to Orange County the report titled "Big Sand Lake Outfall Conceptual Improvements". A complete copy of this report can be posted to ftp for the interested reader.

This report was completed after the August 2003 wall failure but before the 2004 hurricanes and before the emergency replacement of the drainage well. CDM explored four (4) alternatives for controlling the lake level and **they recommended the drainage well alternative** after considering these options:

❶ *New Outfall Pipe to C-1 Canal*

New 24-inch RCP from Big Sand Lake to the C-1 Canal (4,540 lineal ft) with an outfall elevation of +92 ft NGVD. Implementation of this improvement would be difficult because of potential conflicts with existing infrastructure and easement needs along this highly developed corridor. In addition, the VWCD C-1 Canal would be the receiving water body for the new outfall system permitted under this alternative and VWCD is limiting the discharge to 62 cfs. Orange County would also have to develop a bank stabilization plan for the canal segments downstream of VWCD Structures S-101 and S-102 (amil gates). The water resource is also discharged under this alternative. There are concerns with downstream flooding in Shingle Creek, which would lead to a controlled operating schedule to when excess stormwater from Big Sand Lake could be discharged to Shingle Creek. One of the newspaper articles in the next section of this report describes the substantive residential flooding which occurred on Shingle Creek during the 2004 event.

❷ *Replace Lost Drainage Wells*

This alternative considered six (6) drainage well scenarios:

1@ 10-inch diameter well @+90 ft NGVD;	2@ 10-inch diameter well @+90 ft NGVD
1@ 10-inch diameter well @+92 ft NGVD;	2@ 10-inch diameter well @+92 ft NGVD
1@ 10-inch diameter well @+95 ft NGVD;	2@ 10-inch diameter well @+95 ft NGVD

CDM concluded that the replacement of the wells on Big Sand Lake would provide improved lake level management and would provide for aquifer recharge. This was the recommended option in their study.

❸ *Stormwater Pump Station*

The following two (2) pump station scenarios were modeled by CDM:

➟ Three-stage pump system (20 cfs for each pump) with start elevations of:
+ 93 ft NGVD (pump1), +95 ft NGVD (pump 2), +97 ft NGVD (pump 3)
all pumps shut-off when Big Sand Lake water levels recede below elevation +90 ft NGVD; and

➟ Three pump system (10 cfs each pump) with start elevations of:
+ 93 ft NGVD (pump1), +95 ft NGVD (pump 2), +97 ft NGVD (pump 3)
all pumps shut-off when Big Sand Lake water levels recede to elevation +90 ft NGVD;

While the results indicate the theoretical pumps will provide lake level management control, this alternative was found to be impractical for the following reasons:

❋ Bank stabilization will be needed in the C-1 Canal
❋ The pump operation schedule will be dependent upon downstream water levels and it will not be possible to operate the pumps during the wet season unless an emergency permit is granted.
❋ Also note that the receiving water body (Shingle Creek) experienced flooding of residential structures during the 2004 hurricanes so the agencies are not willing to allow pumped discharges into the C-1 Canal. This flooding is described in the next section of this report which contains archived newspaper clippings.

❹ *Stormwater Reuse*

Two (2) stormwater reuse options were explored:

① disinfect and filter and introduce stormwater into the Orange County Utilities reclaimed water system. This system was deemed impractical since the reclaimed system will have little or no capacity when Big Sand Lake requires pumping during periods of excess rainfall when irrigation demand is low.

② introduce the excess stormwater into the wastewater collection system for supplemental reuse. This option is not practical since it will require the utility to increase its plant treatment capacity to handle the surge of stormwater during pumping events.

1.11 Newspaper Articles Describing the 2003-2004 flooding episodes

Table 5 lists several newspaper articles published during and/or related to the 2003-2004 flooding episodes. The full articles can be read in Attachment C.

Table 5. List of Newspaper Articles During 2003-2004 Flooding Episodes

Date	Writer	Title/Subject
August 20, 2003	Melissa Harris, Sentinel Staff Writer	**As Lakes Pour Over Banks, Homeowners' Worries Rise-** Flooding of back yards and submergence of boat docks on Big Sand Lake.
September 8, 2004	Sandra Pedicini and Jim Leusner, Sentinel Staff Writers	**Floods Follow Frances' Deluge** Residents Across Central Florida See Their Yards Fill With Water. As Seminole County waited for the St. Johns River to crest in Sanford, homeowners throughout Central Florida saw their yards slowly fill with water from Hurricane Frances, Big Sand Lake included.
September 11, 2004	Susan Jacobson, Sentinel Staff Writer	**Waters Rise On Elderly** At Good Samaritan Village, Residents Evacuate To Escape Swollen Shingle Creek, which is the high level outfall from Big Sand Lake. Hundreds of elderly residents of Good Samaritan Village have been forced to flee in the wake of post-hurricane flooding that caused sewage and storm water to back up into the streets and some homes to be submerged.
September 20, 2004	Beth Kassab, Sentinel Staff Writer	**Growth's Balancing Act** Residents Hope Well Helps Drain Flooded Lakeside. Though more complicated in reality, the State Department of Environmental Protection has given the go ahead for Orange County to dig a drainage well for Big Sand Lake, which after hurricanes Charley and Frances has swallowed every dock, boathouse and back yard on its perimeter.
September 28, 2004	Kevin Spear, Sentinel Staff Writer	**High Water Imperils Homes, Roadways** Neighborhoods Turn Into Islands As Region's Rivers, Lakes Overflow. In southwest Orange County, a small lake overflowed with Hurricane Jeanne's runoff to block Darlene Drive. Drainage workers had no easy way to move floodwaters off the neighborhood street. Big Sand Lake, already flooding yards and pools, is spilling into Shingle Creek.

Table 5. List of Newspaper Articles During 2003-2004 Flooding Episodes		
Date	**Writer**	**Title/Subject**
January 6, 2005	Beth Kassab, Sentinel Staff Writer	**Asking To Be High And Dry** At The Urging Of Dr. Phillips-area Residents, the Orange County Commission Will Ask The State's Permission To Pump Water Out Of Big Sand Lake. As water continues to lap over boat docks, sink lawn furniture and crack the cement walls that protect swimming pools, people who live on Big Sand Lake are asking. The lake level is at 97 feet, about 7 feet higher than what is considered the normal high elevation for Big Sand Lake.
June 18, 2005	Beth Kassab and Kevin Spear, Sentinel Staff Writers	**What Happens To The Water?** Discussion of drainwells and their impact on the aquifer and mentions the Big Sand Lake drainage well.
October 20, 2005	Sandra Pedicini and Elaine Aradillas, Sentinel Staff Writers	**Already full, lakes may face deluge** Lakes throughout Central Florida are filled to capacity, spilling into streets, yards and, in some places, homes. The region simply cannot take any more rain, and the threat of Hurricane Wilma is making residents and government officials anxious.

2.0 Objectives

Given the present and future practical/permitting limitations associated with the construction of a low-level surface water outfall to the C-1 Canal and with the knowledge that Big Sand Lake stages alarmingly high during periods of excess rainfall (40^{+} inch wet seasons), Orange County Roads & Drainage would like to explore the possibility of adding at least one more drainage well in the same area as the existing well. This will likely provide low level discharges on the order of 1,600 gpm (3.5 cfs) per drainage well provided there are no aquifer transmissivity limitations. For example, a total of three (3) additional wells can provide a low level bleed-down rate of over 10 cfs once the lake stage rises above +91 to +92 ft NGVD.

The purpose of the study is to document the drainage benefit of additional well installations and produce a report which can be submitted to the FDEP to support the need for additional drainage wells.

3.0 Lake Sherwood as a Similar & Successful Project

Big Sand Lake is similar to Lake Sherwood in many respects, including:

① the sheer magnitude and land cover of the watershed (both with 4,500± acres of urbanized land cover),

② land-locked nature with wide range of water level fluctuation and rising dramatically with excess cumulative rainfall (such as a 40-inch rainfall wet season), and

③ historical reliance on drainage wells for lake level control.

After the hurricanes of August-September 2004, FDEP allowed the construction of four (4) 12-inch diameter drainage wells (arranged in an array) at Lake Sherwood to replace the original 24-inch drainage well which was failing. A group of photos of this new drainage well system (taken August 2009) is shown in Photo 5.

This project was completed in June 2005 and the high water levels have been mitigated effectively by the performance of the drainwells as tested during the Gulf Gale rains of May 2009. A chart of the water levels in Lake Sherwood for the period 1960 to August 2009 is in Exhibit 4 and it shows the effectiveness of the new wells.

Ideally, the intent will be to construct a similar facility at Big Sand Lake given the hydrologic and hydrogeologic similarity between these two water bodies (Big Sand Lake & Lake Sherwood).

Photo 5. Lake Sherwood drainage wells in August 2009

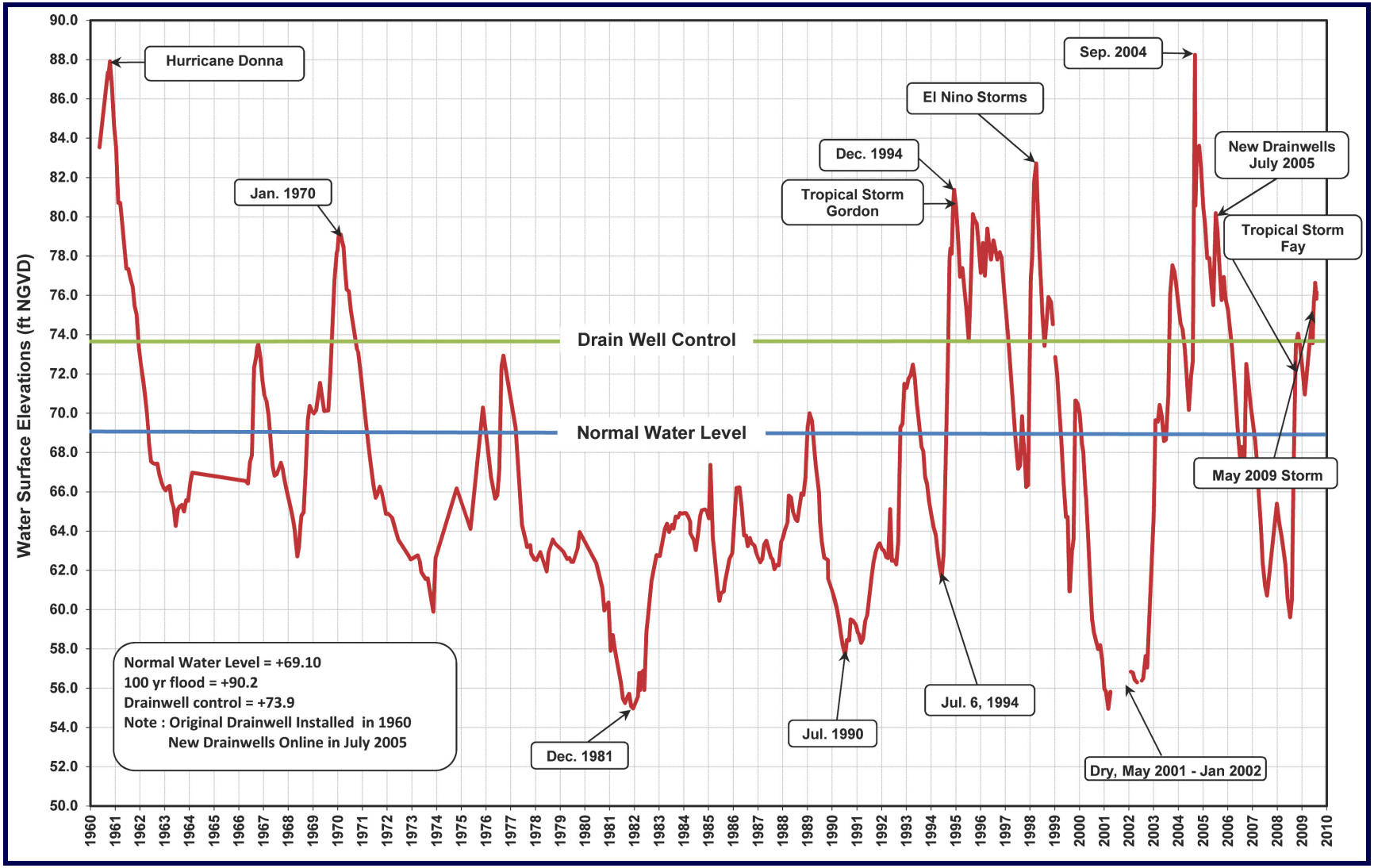

Exhibit 4. Water Surface Elevations in Lake Sherwood

4.0 Potential Drainage Well Discharge Capacities

Exhibit 5 shows the general drainage well capacities which can be expected based on maximum velocities in the drop pipe and the Morning Glory equation. For planning purposes, we can assume that a single 12-inch drainage well will provide approximately 1,500 gpm capacity. Four (4) wells will provide an estimated discharge capacity of 6,000 gpm, compared to 3,000 gpm if only two (2) wells are in the array. Given the size of the Big Sand Lake basin and its drainage similitude to Lake Sherwood, we recommend that the drainage wells at Big Sand Lake and Lake Serene be upgraded to a total four (4) 12-inch diameter drainage wells.

WELL DISCHARGE RATES LIMITED BY WELL DIAMETER

Velocity (fps)	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.25	Morning Glory Weir at 1 ft Head	
Well casing Diameter (inch)												ft/sec in well casing
6	353	375	397	419	441	463	485	507	529	551	776	8.8
8	627	666	705	744	783	823	862	901	940	979	1024	6.5
10	979	1,040	1,102	1,163	1,224	1,285	1,346	1,408	1,469	1,530	1303	5.3
12	1,410	1,498	1,586	1,674	1,763	1,851	1,939	2,027	2,115	2,203	1551	4.4
14	1,919	2,039	2,159	2,279	2,399	2,519	2,639	2,759	2,879	2,999	2126	4.4
16	2,507	2,663	2,820	2,977	3,133	3,290	3,447	3,603	3,760	3,917	2606	4.2
18	3,173	3,371	3,569	3,767	3,966	4,164	4,362	4,561	4,759	4,957	3490	4.4
20	3,917	4,162	4,406	4,651	4,896	5,141	5,386	5,630	5,875	6,120	4330	4.4
24	5,640	5,993	6,345	6,698	7,050	7,403	7,755	8,108	8,460	8,813	6205	4.4

Exhibit 5. Estimated drainage well capacities

5.0 Summary & Recommendations

During calendar years 2003 to 2005, Big Sand Lake experienced prolonged periods of very high lake levels, such high water elevations not being reached since 1961-62 when Big Sand Lake was still recovering from its Hurricane Donna peak. Note that in the early 1960's the shoreline/watershed of Big Sand Lake was mainly undeveloped and very different from its present highly urbanized land cover. In fact, development within this basin accelerated only since the mid 1990's. These contemporary 2003-2004 high water encroachments were dramatic and caused property damage in addition to raising a flooding fear among the shoreline residents, especially when the wave height was added to the peak stage. This water body has a significant fetch and hurricane strength winds can generate 2 to 3 ft high waves which aggravate the shoreline damage. The high water levels occurred during wet seasons (June-September) with more than 40 inches of rainfall, compared to normal wet season rainfall averages of 26.5 inches.

Since Hurricane Donna in 1960, the Big Sand Lake watershed has transformed into a highly urbanized land cover comprising residential and commercial developments, with a resulting increase in stormwater runoff volumes. Since that 2003-2005 high water event, the lake's discharge capacity through its only high-level outfall has been established at a maximum of 62 cfs by the agency regulating the receiving water body into which Big Sand Lake outfalls. Another limitation is that permanent or temporary pumping permits are not easily granted since SFWMD is concerned about flooding in Shingle Creek which is the receiving water body. There was significant residential flooding on Shingle Creek during the 2004 hurricanes. Therefore, since the discharge into Shingle Creek cannot be increased (pumped or gravity), the only option viable would be to increase the recharge rate into the Floridan Aquifer through drainage wells.

After the three (3) hurricanes of August-September 2004, the Florida Department Of Environmental Protection (FDEP) allowed the installation of one (1) 12-inch diameter drainage well in October 2004 to help mitigate the flooding. Based on recent conversations with FDEP staff (March 2013), they are willing to consider the installation of additional wells if sufficient "drainage-need" justification is provided.

The FDEP has conceptually agreed to the addition of one (1) more well on Big Sand Lake as a replacement for the "lost" Lake Serene drainage well (see documentation in Attachment B). However, our evaluation herein suggests that a total of four (4) 12-inch diameter drainage wells are required for effective lake level control, based on the observed performance of the similar-sized Lake Sherwood basin which is near to the Big Sand Lake basin. Since the Lake Serene drainage well replacement has been approved, we recommend that the County pursue two (2) additional 12-in diameter wells as part of their long-term plan for flood mitigation in this basin.

Four (4) 12-inch diameter drainage wells will provide much more effective lake level control and recovery without aggravating downstream impacts in Shingle Creek.

FIGURES

NORTH

GRAPHIC SCALE
1 INCH = 2,000 FEET

1,000 0 500 1,000 2,000 4,000

Wallace Rd.

Apopka Vineland Rd.

Spring Lake
1500

Turkey Lake Rd.

Control Weir and Culverts

1350

Sand Lake Rd.

Little Sand Lake
1300

4

Historical Drainage Well
(1494053494574)

Lake Serene
1100

Emergency Overflow Pipe

Location of failed retention wall

Big Sand Lake

0700

0900

Lake Boo Boo

International Dr.

Apopka Vineland Rd.

New Drainage well Constructed in (Oct 2004)

Open Channel Connection between Lobes of Big Sand Lake

Outfall Pipe to Big Sand Lake

Historical Drainage Well
(1485920500541)

528

0500

Lake Crowell

0100

Big Sand Lake

0150

0200

0250

Outfall Pipe to Big Sand Lake

Central Florida Pkwy

C-1 Canal

0300

Lake Wills

4

Basin Area = 5,400 acres

LEGEND

- Basin Boundary
- Sub-Basin Boundaries
- Junctions

Conduits

- CROSS DRAIN
- OPEN CHANNEL
- STORMPIPE
- WEIR

DEVO Engineering
CONSULTING GEOTECHNICAL ENGINEERS
5500 Alhambra Drive, Orlando, Florida 32808
Phone: (407) 290-2371 • Fax: (407) 298-9011
E-Mail address: devo@devoeng.com
Website: http://www.devoeng.com

Figure Name:
Basin Boundary on Aerial Map
Photo Date : Jan 2013

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 1.1

NORTH

GRAPHIC SCALE
1 INCH = 2,000 FEET

1,000 0 500 1,000 2,000 4,000

Wallace Rd.

Apopka Vineland Rd.

Spring Lake
1500

Control Weir and
Culverts

1350

Sand Lake Rd.

AR 1 219-7

DEV-6[illegible] - 67

Little Sand
Lake
1300

Historical Drainage Well
(1494053494574)

Lake
Serene
1100

Emergency Overflow
Pipe

Location of failed
retention wall

Big Sand Lake

0700

0900

Lake
Boo Boo

Apopka Vineland Rd.

Open Channel Connection
between Lobes of Big Sand Lake

New Drainage well
Constructed in (Oct 2004)

Outfall Pipe to
Big Sand Lake

Historical Drainage Well
(1485920500541)

Lake
Crowell
0500

1954 Aerial Map coverage for this area not avaiable and is substituted with a 2013 aerial

0100

Big Sand
Lake

C-1 Canal

Outfall Pipe to
Big Sand Lake

Lake
Wills

Basin Area = 5,400 acres

LEGEND

- Basin Boundary
- Sub-Basin Boundaries
- Junctions

Conduits

- CROSS DRAIN
- OPEN CHANNEL
- STORMPIPE
- WEIR

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CONSULTING GEOTECHNICAL ENGINEERS
5500 Alhambra Drive, Orlando, Florida 32808
Phone: (407) 290-2371 • Fax: (407) 298-9011
E-Mail addresss: devo@devoeng.com
Website: http://www.devoeng.com

Figure Name:
Basin Boundary on Historical Aerial Map (Photo Date : March 1947)

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 2.1

NORTH

GRAPHIC SCALE
1 INCH = 2,000 FEET

1,000 0 500 1,000 2,000 4,000

Wallace Rd.

Apopka Vineland Rd.

Spring Lake
1500

Control Weir and
Culverts

1350

Sand Lake Rd.

Little Sand
Lake
1300

Historical Drainage Well
(1494053494574)

Lake
Serene

1100

Emergency Overflow
Pipe

Location of failed
retention wall

Big Sand Lake

0700

0900

Lake
Boo Boo

Apopka Vineland Rd.

Open Channel Connection
between Lobes of Big Sand Lake

New Drainage well
Constructed in (Oct 2004)

Outfall Pipe to
Big Sand Lake

Historical Drainage Well
(1485920500541)

0500

Lake
Crowell

0100

Big Sand
Lake

C-1 Canal

Outfall Pipe to
Big Sand Lake

Lake
Wills

1954 Aerial Map coverage for this area not avaiable and is substituted with a 2013 aerial

Basin Area = 5,400 acres

LEGEND

- Basin Boundary
- Sub-Basin Boundaries
- Junctions

Conduits

- CROSS DRAIN
- OPEN CHANNEL
- STORMPIPE
- WEIR

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CONSULTING GEOTECHNICAL ENGINEERS
5500 Alhambra Drive, Orlando, Florida 32808
Phone: (407) 290-2371 • Fax: (407) 298-9011
E-Mail addresss: devo@devoeng.com
Website: http://www.devoeng.com

Figure Name:
Basin Boundary on Historical Aerial Map (Photo Date : March 1954)

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 2.2

NORTH

GRAPHIC SCALE
1 INCH = 2,000 FEET
1,000 0 500 1,000 2,000 4,000

T 2 - S 7

Wallace Rd.

Apopka Vineland Rd.

Spring Lake
1500

Control Weir and
Culverts

1350

Sand Lake Rd.

Little Sand
Lake
1300

Lake
Serene

Historical Drainage Well
(1494053494574)

1100

Emergency Overflow
Pipe

Location of failed
retention wall

Big Sand Lake

0700

0900

Lake
Boo Boo

Open Channel Connection
between Lobes of Big Sand Lake

New Drainage well
Constructed in (Oct 2004)

Outfall Pipe to
Big Sand Lake

Historical Drainage Well
(1485920500541)

0500

Lake
Crowell

0100

Big Sand
Lake

C-1 Canal

Outfall Pipe to
Big Sand Lake

Lake
Wills

1954 Aerial Map coverage for this area not avaiable and is substituted with a 2013 aerial

Basin Area = 5,400 acres

LEGEND

- Basin Boundary
- Sub-Basin Boundaries
- Junctions

Conduits

- CROSS DRAIN
- OPEN CHANNEL
- STORMPIPE
- WEIR

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CONSULTING GEOTECHNICAL ENGINEERS
5500 Alhambra Drive, Orlando, Florida 32808
Phone: (407) 290-2371 • Fax: (407) 298-9011
E-Mail address: devo@devoeng.com
Website: http://www.devoeng.com

Figure Name:
Basin Boundary on Historical Aerial Map (Photo Date : Jan 1957)

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 2.3

NORTH

GRAPHIC SCALE
1 INCH = 2,000 FEET
1,000 0 500 1,000 2,000 4,000

SR 400

Wallace Rd.

Apopka Vineland Rd.

Spring Lake
1500

Control Weir and
Culverts

1350

Sand Lake Rd.

Little Sand
Lake
1300

Historical Drainage Well
(1494053494574)

Lake
Serene

1100

Emergency Overflow
Pipe

Location of failed
retention wall

Big Sand Lake

0700

0900

Lake
Boo Boo

Apopka Vineland Rd.

Open Channel Connection
between Lobes of Big Sand Lake

New Drainage well
Constructed in (Oct 2004)

Outfall Pipe to
Big Sand Lake

Historical Drainage Well
(1485920500541)

0500

Lake
Crowell

0100

Big Sand
Lake

C-1 Canal

Outfall Pipe to
Big Sand Lake

Lake
Wills

1954 Aerial Map coverage for this area not avaiable and is substituted with a 2013 aerial

Basin Area = 5,400 acres

LEGEND

- Basin Boundary
- Sub-Basin Boundaries
- Junctions

Conduits

- CROSS DRAIN
- OPEN CHANNEL
- STORMPIPE
- WEIR

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CONSULTING GEOTECHNICAL ENGINEERS
5500 Alhambra Drive, Orlando, Florida 32808
Phone: (407) 290-2371 • Fax: (407) 298-9011
E-Mail addresss: devo@devoeng.com
Website: http://www.devoeng.com

Figure Name:
Basin Boundary on Historical Aerial Map (Photo Date : Jan 1962)

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 2.4

NORTH

GRAPHIC SCALE
1 INCH = 2,000 FEET

1,000 0 500 1,000 2,000 4,000

Wallace Rd.

Apopka Vineland Rd.

Spring Lake
1500

Control Weir and
Culverts

1350

Sand Lake Rd.

Little Sand
Lake
1300

Historical Drainage Well
(1494053494574)

Lake
Serene
1100

Emergency Overflow
Pipe

Location of failed
retention wall

Big Sand Lake

0700

0900

Lake
Boo Boo

Apopka Vineland Rd.

Open Channel Connection
between Lobes of Big Sand Lake

New Drainage well
Constructed in (Oct 2004)

Outfall Pipe to
Big Sand Lake

Historical Drainage Well
(1485920500541)

0500

Lake
Crowell

0100

Big Sand
Lake

C-1 Canal

Outfall Pipe to
Big Sand Lake

Lake
Wills

1954 Aerial Map coverage for this area not avaiable and is substituted with a 2013 aerial

Basin Area = 5,400 acres

LEGEND

- Basin Boundary
- Sub-Basin Boundaries
- Junctions

Conduits

- CROSS DRAIN
- OPEN CHANNEL
- STORMPIPE
- WEIR

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Website: http://www.devoeng.com

Figure Name:
Basin Boundary on Historical Aerial Map (Photo Date : Jan 1963)

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 2.5

NORTH

GRAPHIC SCALE
1 INCH = 2,000 FEET

1,000 0 500 1,000 2,000 4,000

Wallace Rd.

Apopka-Vineland Rd.

Spring Lake
1500

Control Weir and
Culverts

1350

Sand Lake Rd.

Little Sand
Lake
1300

Historical Drainage Well
(1494053494574)

Lake
Serene
1100

Emergency Overflow
Pipe

Location of failed
retention wall

Big Sand Lake

0700

0900

Lake
Boo Boo

Open Channel Connection
between Lobes of Big Sand Lake

New Drainage well
Constructed in (Oct 2004)

Outfall Pipe to
Big Sand Lake

Historical Drainage Well
(1485920500541)

Lake
Crowell
0500

0100

Big Sand
Lake

C-1 Canal

Outfall Pipe to
Big Sand Lake

Lake
Wills

1954 Aerial Map coverage for this area not avaiable and is substituted with a 2013 aerial

Basin Area = 5,400 acres

LEGEND

- Basin Boundary
- Sub-Basin Boundaries
- Junctions

Conduits

- CROSS DRAIN
- OPEN CHANNEL
- STORMPIPE
- WEIR

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CONSULTING GEOTECHNICAL ENGINEERS
5500 Alhambra Drive, Orlando, Florida 32808
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E-Mail address: devo@devoeng.com
Website: http://www.devoeng.com

Figure Name:
Basin Boundary on Historical Aerial Map (Photo Date : Nov. 1969)

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 2.6

NORTH

GRAPHIC SCALE
1 INCH = 2,000 FEET

1,000 0 500 1,000 2,000 4,000

Wallace Rd.

Apopka Vineland Rd.

Spring Lake
1500

Control Weir and Culverts

1350

Sand Lake Rd.

Little Sand Lake
1300

Historical Drainage Well
(1494053494574)

Lake Serene
1100

Emergency Overflow Pipe

Location of failed retention wall

Big Sand Lake

0700

0900

Lake Boo Boo

Open Channel Connection between Lobes of Big Sand Lake

New Drainage well Constructed in (Oct 2004)

Outfall Pipe to Big Sand Lake

Historical Drainage Well
(1485920500541)

0500

Lake Crowell

0100

Big Sand Lake

C-1 Canal

Outfall Pipe to Big Sand Lake

4

Lake Wills

Basin Area = 5,400 acres

LEGEND

- Basin Boundary
- Sub-Basin Boundaries
- Junctions

Conduits

- CROSS DRAIN
- OPEN CHANNEL
- STORMPIPE
- WEIR

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CONSULTING GEOTECHNICAL ENGINEERS
5500 Alhambra Drive, Orlando, Florida 32808
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Figure Name:
Basin Boundary on Historical Aerial Map (Photo Date : Nov. 1974)

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 2.7

pd - 2123

NORTH

GRAPHIC SCALE
1 INCH = 2,000 FEET

1,000 0 500 1,000 2,000 4,000

Wallace Rd.

Apopka Vineland Rd.

Spring Lake
1500

Control Weir and
Culverts

1350

Sand Lake Rd.

Little Sand
Lake
1300

Historical Drainage Well
(1494053494574)

Lake
Serene
1100

Emergency Overflow
Pipe

Location of failed
retention wall

Big Sand Lake

0700

0900

Lake
Boo Boo

Apopka-Vineland Rd.

Open Channel Connection
between Lobes of Big Sand Lake

New Drainage well
Constructed in (Oct 2004)

Outfall Pipe to
Big Sand Lake

Historical Drainage Well
(1485920500541)

0500

Lake
Crowell

0100

Big Sand
Lake

C-1 Canal

Outfall Pipe to
Big Sand Lake

4

Lake
Wills

Basin Area = 5,400 acres

LEGEND

Basin Boundary

Sub-Basin Boundaries

Junctions

Conduits

CROSS DRAIN

OPEN CHANNEL

STORMPIPE

WEIR

DEVO Engineering
CONSULTING GEOTECHNICAL ENGINEERS
5500 Alhambra Drive, Orlando, Florida 32808
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Website: http://www.devoeng.com

Figure Name:
Basin Boundary on Historical Aerial Map (Photo Date : Nov. 1978)

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 2.8

NORTH

GRAPHIC SCALE
1 INCH = 2,000 FEET

1,000 0 500 1,000 2,000 4,000

Wallace Rd.

Apopka Vineland Rd.

Spring Lake
1500

Control Weir and
Culverts

1350

Sand Lake Rd.

Little Sand
Lake
1300

Historical Drainage Well
(1494053494574)

Lake
Serene
1100

Emergency Overflow
Pipe

Location of failed
retention wall

Big Sand Lake

0700

0900

Lake
Boo Boo

Apopka Vineland Rd.

Open Channel Connection
between Lobes of Big Sand Lake

New Drainage well
Constructed in (Oct 2004)

Outfall Pipe to
Big Sand Lake

Historical Drainage Well
(1485920500541)

0500

Lake
Crowell

0100

Big Sand
Lake

C-1 Canal

Outfall Pipe to
Big Sand Lake

4

Lake
Wills

Basin Area = 5,400 acres

LEGEND

- Basin Boundary
- Sub-Basin Boundaries
- Junctions

Conduits

- CROSS DRAIN
- OPEN CHANNEL
- STORMPIPE
- WEIR

DEVO Engineering
CONSULTING GEOTECHNICAL ENGINEERS
5500 Alhambra Drive, Orlando, Florida 32808
Phone: (407) 290-2371 • Fax: (407) 298-9011
E-Mail addresss: devo@devoeng.com
Website: http://www.devoeng.com

Figure Name:
Basin Boundary on Historical Aerial Map (Photo Date : Feb 1990)

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 2.9

NORTH

GRAPHIC SCALE
1 INCH = 2,000 FEET

1,000 0 500 1,000 2,000 4,000

Wallace Rd.

Apopka Vineland Rd.

Spring Lake
1500

Control Weir and
Culverts

1350

Sand Lake Rd.

Little Sand
Lake
1300

Historical Drainage Well
(1494053494574)

Lake
Serene
1100

Emergency Overflow
Pipe

Location of failed
retention wall

Big Sand Lake

0700

0900

Lake
Boo Boo

Apopka Vineland Rd.

Open Channel Connection
between Lobes of Big Sand Lake

New Drainage well
Constructed in (Oct 2004)

Outfall Pipe to
Big Sand Lake

Historical Drainage Well
(1485920500541)

0500

Lake
Crowell

0100

Big Sand
Lake

3048

C-1 Canal

Outfall Pipe to
Big Sand Lake

Lake
Wills

Basin Area = 5,400 acres

LEGEND

- Basin Boundary
- Sub-Basin Boundaries
- Junctions

Conduits

- CROSS DRAIN
- OPEN CHANNEL
- STORMPIPE
- WEIR

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Website: http://www.devoeng.com

Figure Name:
Basin Boundary on Historical Aerial Map (Photo Date : April 1995)

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 2.10

NORTH

GRAPHIC SCALE
1 INCH = 2,000 FEET

1,000 0 500 1,000 2,000 4,000

Wallace Rd.

Apopka Vineland Rd.

Spring Lake
1500

Control Weir and
Culverts

1350

Sand Lake Rd.

Little Sand
Lake
1300

Historical Drainage Well
(1494053494574)

Lake
Serene
1100

Emergency Overflow
Pipe

Location of failed
retention wall

Big Sand Lake

0700

0900

Lake
Boo Boo

Apopka-Vineland Rd.

Open Channel Connection
between Lobes of Big Sand Lake

New Drainage well
Constructed in (Oct 2004)

Outfall Pipe to
Big Sand Lake

Historical Drainage Well
(1485920500541)

0500

Lake
Crowell

0100

Big Sand
Lake

C-1 Canal

Outfall Pipe to
Big Sand Lake

Lake
Wills

Basin Area = 5,400 acres

LEGEND

- Basin Boundary
- Sub-Basin Boundaries
- Junctions

Conduits

- CROSS DRAIN
- OPEN CHANNEL
- STORMPIPE
- WEIR

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Website: http://www.devoeng.com

Figure Name:
Basin Boundary on Historical Aerial Map (Photo Date : Feb 1999)

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 2.11

NORTH

GRAPHIC SCALE
1 INCH = 2,000 FEET

1,000 0 500 1,000 2,000 4,000

Wallace Rd.

Apopka Vineland Rd.

Spring Lake
1500

Control Weir and
Culverts

1350

Sand Lake Rd.

Little Sand
Lake
1300

Historical Drainage Well
(1494053494574)

Lake
Serene
1100

Emergency Overflow
Pipe

Location of failed
retention wall

Big Sand Lake

0700

0900

Lake
Boo Boo

Apopka Vineland Rd.

Open Channel Connection
between Lobes of Big Sand Lake

New Drainage well
Constructed in (Oct 2004)

Outfall Pipe to
Big Sand Lake

Historical Drainage Well
(1485920500541)

0500

Lake
Crowell

0100

Big Sand
Lake

C-1 Canal

Outfall Pipe to
Big Sand Lake

Lake
Wills

Basin Area = 5,400 acres

LEGEND

- Basin Boundary
- Sub-Basin Boundaries
- Junctions

Conduits

- CROSS DRAIN
- OPEN CHANNEL
- STORMPIPE
- WEIR

DEVO Engineering
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E-Mail address: devo@devoeng.com
Website: http://www.devoeng.com

Figure Name:
Basin Boundary on Historical Aerial Map (Photo Date : April 2002)

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 2.12

NORTH

GRAPHIC SCALE

1 INCH = 500 FEET

250 0 125 250 500 1,000

Lake Sloat

Lake Tucker

Apopka Vineland Rd.

Historical Drainage Well (1494053494574)

Lake Serene

Big Sand Lake

Historical Drainage Well (1485920500541)

Big Sand Lake

DEVO Engineering

CONSULTING GEOTECHNICAL ENGINEERS

5500 Alhambra Drive, Orlando, Florida 32808 Phone: (407) 290-2371 • Fax: (407) 298-9011

E-Mail address: devo@devoeng.com Website: http://www.devoeng.com

Figure Name:

Magnified Views - Historical Aerial Map

Aerial Map (Photo Date : March 1947)

Project Name: **Big Sand Lake Drainage Well**

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 3.1

NORTH

GRAPHIC SCALE

1 INCH = 500 FEET

250 0 125 250 500 1,000

Lake Tucker

Lake Sloat

Apopka Vineland Rd.

Historical Drainage Well (1494053494574)

Lake Serene

Big Sand Lake

Historical Drainage Well (1485920500541)

Big Sand Lake

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E-Mail address: devo@devoeng.com
Website: http://www.devoeng.com

Figure Name:

Magnified Views - Historical Aerial Map

Aerial Map (Photo Date : March 1954)

Project Name:

Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 3.2

NORTH

GRAPHIC SCALE

1 INCH = 500 FEET

250 0 125 250 500 1,000

Lake Tucker

Lake Sloat

Apopka Vineland Rd.

Historical Drainage Well (1494053494574)

Lake Serene

Big Sand Lake

Historical Drainage Well (1485920500541)

Big Sand Lake

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Website: http://www.devoeng.com

Figure Name:

Magnified Views - Historical Aerial Map

Aerial Map (Photo Date : Jan 1957)

Project Name:

Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 3.3

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Website: http://www.devoeng.com

Figure Name:
Magnified Views - Historical Aerial Map
Aerial Map (Photo Date : Jan 1962)

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 3.4

NORTH

GRAPHIC SCALE

1 INCH = 500 FEET

250 0 125 250 500 1,000

Historical Drainage Well
(1485920500541)

Big Sand Lake

DEVO Engineering
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5500 Alhambra Drive, Orlando, Florida 32808
Phone: (407) 290-2371 • Fax: (407) 298-9011
E-Mail address: devo@devoeng.com
Website: http://www.devoeng.com

Figure Name:

Magnified Views - Historical Aerial Map

Aerial Map (Photo Date : Jan 1963)

Project Name:

Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 3.5

NORTH

GRAPHIC SCALE
1 INCH = 500 FEET

250 0 125 250 500 1,000

Lake Sloat

Lake Tucker

Apopka Vineland Rd.

Historical Drainage Well (1494053494574)

Lake Serene

Big Sand Lake

Historical Drainage Well (1485920500541)

Big Sand Lake

DEVO Engineering
CONSULTING GEOTECHNICAL ENGINEERS
5500 Alhambra Drive, Orlando, Florida 32808
Phone: (407) 290-2371 • Fax: (407) 298-9011
E-Mail address: devo@devoeng.com
Website: http://www.devoeng.com

Figure Name:
Magnified Views - Historical Aerial Map
Aerial Map (Photo Date : Nov. 1969)

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 3.6

NORTH

GRAPHIC SCALE

1 INCH = 500 FEET

250 0 125 250 500 1,000

Lake Sloat

Lake Tucker

Apopka Vineland Rd.

Historical Drainage Well (1494053494574)

Lake Serene

Big Sand Lake

Historical Drainage Well (1485920500541)

Big Sand Lake

DEVO Engineering

CONSULTING GEOTECHNICAL ENGINEERS

5500 Alhambra Drive, Orlando, Florida 32808
Phone: (407) 290-2371 • Fax: (407) 298-9011
E-Mail addresss: devo@devoeng.com
Website: http://www.devoeng.com

Figure Name:

Magnified Views - Historical Aerial Map

Aerial Map (Photo Date : Nov. 1974)

Project Name:

Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 3.7

NORTH

GRAPHIC SCALE

1 INCH = 500 FEET

250 0 125 250 500 1,000

Lake Sloat

Lake Tucker

Apopka Vineland Rd.

Historical Drainage Well (1494053494574)

Lake Serene

Big Sand Lake

Historical Drainage Well (1485920500541)

Big Sand Lake

DEVO Engineering
CONSULTING GEOTECHNICAL ENGINEERS
5500 Alhambra Drive, Orlando, Florida 32808
Phone: (407) 290-2371 • Fax: (407) 298-9011
E-Mail addresss: devo@devoeng.com
Website: http://www.devoeng.com

Figure Name:

Magnified Views - Historical Aerial Map

Aerial Map (Photo Date : Nov. 1978)

Project Name: **Big Sand Lake Drainage Well**

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 3.8

NORTH

GRAPHIC SCALE

1 INCH = 2,000 FEET

1,000 0 500 1,000 2,000 4,000

Wallace Rd.

Apopka Vineland Rd.

Spring Lake
W.E. 95.9

Tuck Lake Rd.

Sand Lake Rd.

Little Sand Lake
W.E. 84.4

W.E. 95.8

W.E. 96.1

Historical Drainage Well
(1494053494574)

Lake Serene
W.E. 91.4

Big Sand Lake
W.E. 86.8

W.E. 86.8

Apopka Vineland Rd.

International Dr.

W.E. 90.1

Lake Boo Boo

New Drainage well
Constructed in (Oct 2004)

W.E. 86.8

Historical Drainage Well
(1485920500541)

528

Lake Crowell

W.E. 86.8

Big Sand Lake
W.E. 86.8

Central Florida Pkwy

C-1 Canal

W.E. 103.3

Lake Wills

Basin Area = 5,400 acres

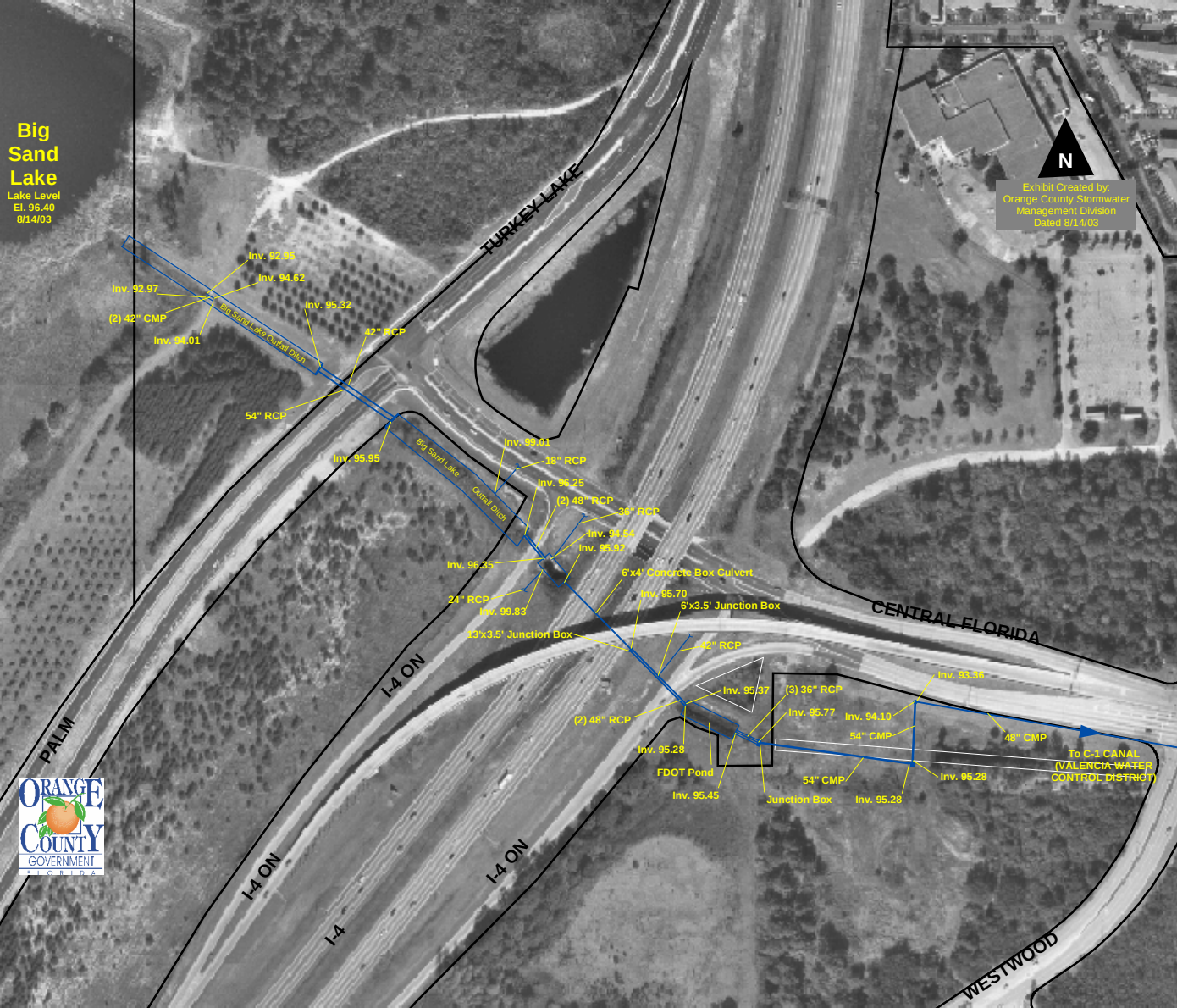
DEVO Engineering
CONSULTING GEOTECHNICAL ENGINEERS
5500 Alhambra Drive, Orlando, Florida 32808
Phone: (407) 290-2371 • Fax: (407) 298-9011
E-Mail addresss: devo@devoeng.com
Website: http://www.devoeng.com

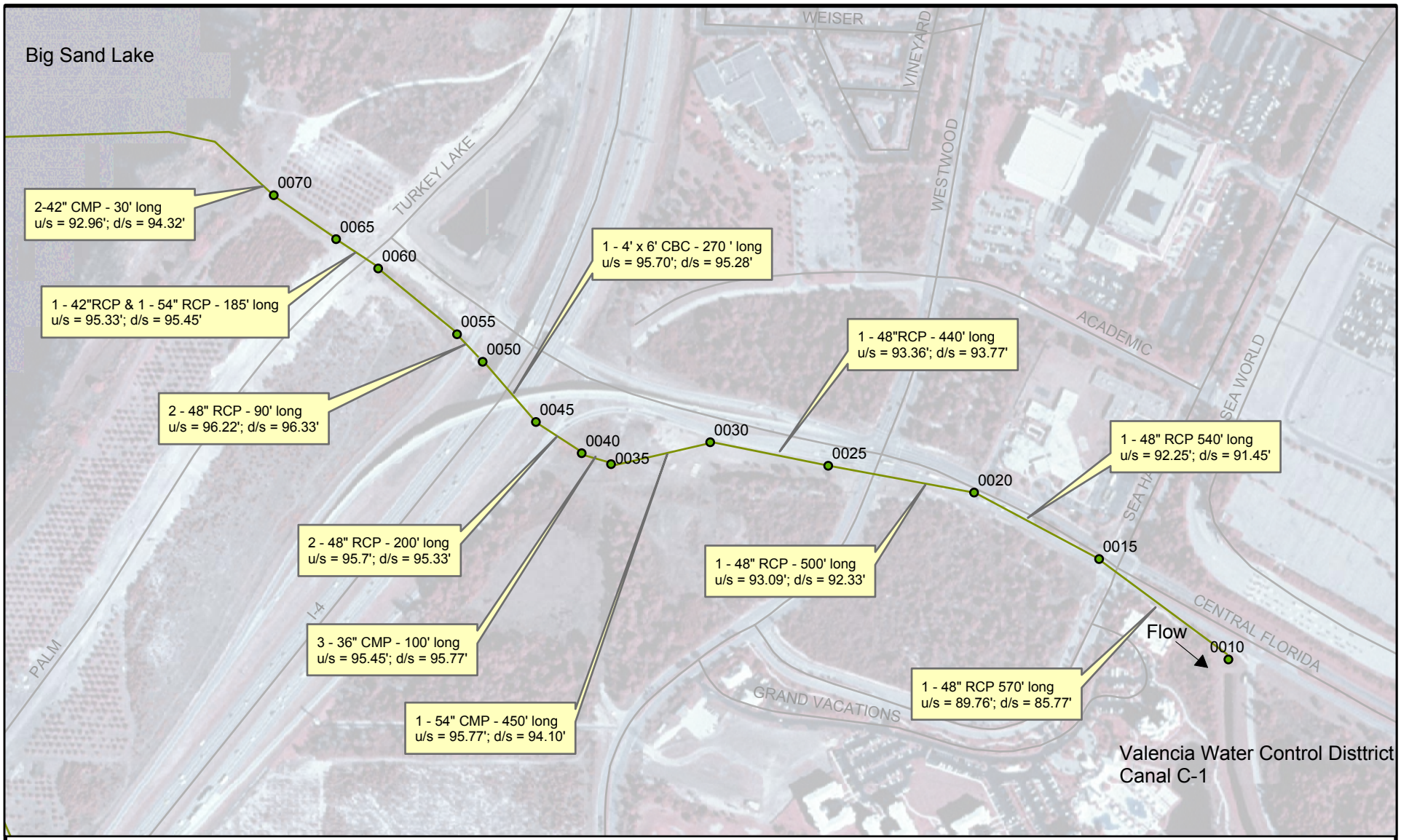
Figure Name:
LIDAR Topo on Aerial Map
Photo Date : Jan 2013

Project Name:
Big Sand Lake Drainage Well

Checked & Approved By:	Drawn By:	Date:	Scale:	Project #	
DS	SM	03-11-2013	NOTED	13-610.53	FIGURE 4.1

ATTACHMENT A
OUTFALL FROM BIG SAND LAKE TO C-1 CANAL


Big Sand Lake
Lake Level
El. 96.40
8/14/03
N
Exhibit Created by:
Orange County Stormwater Management Division
Dated 8/14/03
TURKEY LAKE
Inv. 92.93
Inv. 94.62
Inv. 92.97
(2) 42" CMP
Inv. 95.32
Inv. 94.01
Big Sand Lake Outfall Ditch
42" RCP
54" RCP
Inv. 95.95
Big Sand Lake Outfall Ditch
Inv. 99.01
18" RCP
Inv. 96.25
(2) 48" RCP
36" RCP
Inv. 94.64
Inv. 95.62
Inv. 96.35
6'x4' Concrete Box Culvert
24" RCP
Inv. 99.83
Inv. 95.70
6'x3.5' Junction Box
13'x3.5' Junction Box
42" RCP
CENTRAL FLORIDA
I-4 ON
PALM
Inv. 95.37
(3) 36" RCP
Inv. 93.36
(2) 48" RCP
Inv. 95.77
Inv. 94.10
54" CMP
48" CMP
Inv. 95.28
FDOT Pond
Inv. 95.45
54" CMP
Junction Box
Inv. 95.28
Inv. 95.28
To C-1 CANAL
(VALENCIA WATER CONTROL DISTRICT)
I-4 ON
I-4 ON
I-4
WESTWOOD
ORANGE COUNTY GOVERNMENT FLORIDA



CDM

Figure 2-8
Stormwater Management Model Outfall Configuration

ATTACHMENT B
LAKE SERENE DRAINAGE WELL

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

CENTRAL DISTRICT
3319 MAGUIRE BOULEVARD, SUITE 232
ORLANDO, FLORIDA 32803

RICK SCOTT
GOVERNOR

HERSCHEL T. VINYARD JR.
SECRETARY

May 29, 2013

Sent via email: maricela.torres@ocfl.net

Maricela Torres, P.E.
Chief Engineer
Orange County Public Works Department
Roads and Drainage Division
4200 South John Young Parkway
Orlando, FL 32839-9250

OCD-UIC-13-1613

Re: Orange County – UIC
Lake Serene Drainage Well Replacement

Dear Ms. Torres:

The Department reviewed your May 22, 2013 letter, former drainage well documentation, and request for a drainage well replacement at Lake Serene. The documentation is sufficient, and the Department grants conceptual approval to replace the drainage well. Please submit a well inventory (1-mile radius) justification report, the technical plans and specifications discussed in your letter. The Department also approves locating the replacement well in the immediate vicinity of the existing drainage well on Big Sand Lake. Once the Department grants final approval, the replacement work can commence.

Should you have any questions, please contact Duane Watroba at (407) 897-4119 or via email at duane.watroba@dep.state.fl.us.

Sincerely,

Caroline Shine

Caroline Shine, Environmental Administrator
Drinking Water/UIC/Groundwater Permitting
(407) 897-2927

CS/akd/dw/ply

cc: David Kincaid, P.G., Devo Engineering (via email: dave@devoeng.com)
George Heuler, UIC, Tallahassee

Serene 1-7

FORM NO 9-1904— A

SITE NO. 282636081300801

U.S. DEPT. OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GROUND WATER SITE INVENTORY
SITE SCHEDULE

Recorded by J. C. Fiduk

Date 8/27/79

Check One X English ____ Metric Units

(DR. PHILLIPS)

GENERAL SITE DATA (0)

Site Ident No 28,36,08,1,30,08,01 (5–19) | RG Number R=0 | Transaction T=A D M V (add, delete, modify, verified)

Site-Type 2=C D H I M P T W (collector, drain, sinkhole, connector, multiple, pond, tunnel or, well shaft) | Data Reliability 3=C U L M (field checked, unchecked, location not accurate, minimal data) | Reporting Agency 4=USGS

Project No. 5=15400 | District 6=125 | State 7=12 | County (or town) Orange 8=095

Latitude 9=28,26,36 (deg min sec) | Longitude 10=081,30,08 (deg min sec) | Lat-Long Accuracy 11=S F T M (sec, 5 sec, 10 sec, Min)

Local Number 12=8261309 3 | Land Net Loc. 13=SWSENWS 34 T 23S R 28E (1/4 1/4 1/4 section, township, range, merid)

Location Map 14=WINDERMERE | Scale 15=24000

Altitude 16=101.78 | Method of Measurement 17=A L M (altimeter, level, map) | Accuracy 18=5.0

Topo Setting 19=D C E F H K L Ø P S T U V W (depression, stream, dunes, flat, hilltop, sink, swamp, offshore, pediment, hillside, terrace, undulating, valley, upland flat draw, channel) | Hydrologic Unit (OWDC) 20=03090101

Date of First Construction/Completion 21=1/1/1960 (month day year) | Use of Site 23=A D E G H Ø M P R S T U W X Z (anode, drain, geothermal, seismic, heat reserv, observation, mine, oil or gas, recharge, repress, test, unused, withdrawal, waste, destroyed)

Use of Water 24=A B C D E F H I M N P R S T U Y Z (air cond., bottling, commercial, dewater, power, fire, domestic, irrigation, medicinal, industrial, public supply, recreation, stock, institution, unused, desal, other)

Secondary Water Use 25= | Tertiary Use of Water 26= | Depth of Hole 27=366. | Depth of Well 28=366. | Source of Depth Data① 29=L

Water Level 30=33.12 | Date Measured 31=05/15/1979 (month day year) | Source① 33=S

Method of Measurement 34=A C E G H L M R S T V Z (airline, calibrated airline, estimated, pressure, calibrated pressure gage, geophysical logs, manometer, reported, steel tape, electric tape, calibrated electric tape, other)

Site Status 37=D F G H Ø P R S T V X Z (dry, flowing, nearby flowing, nearby recently flowing, obstruction, pumping, recently pumped, nearby pumping, nearby recently pumped, foreign substance, surface water effects, other)

Source of Geohydrologic Data① 36=S | Pump Used 35=W (no) | Measuring Point 266=0.0 | Measuring Point Date 267=05/15/1979 (month day year)

OWNER IDENTIFICATION (1)

R=158 | T=A D M (add, delete, modify) | Date of Ownership 159#1/1/1960 (month day year)

Name: Last 161=MIWUTC HAID CO. | First 162= | Middle Initial 163=

OTHER SITE IDENTIFICATION NUMBERS (1)

R=189 | T=A [redacted] M (add, delete, modify) | Ident 190# [redacted] | Assigner 191=

New Card Same R & T | Ident 190# | Assigner 191=

SITE VISIT DATA (1)

R=186 | T=A D M (add, delete, modify) | Date of Visit 187#05/15/1979 (month day year) | Name of Person 188=SCHIVER

FIELD WATER QUALITY MEASUREMENTS (1)

R=192 | T=A D M (add, delete, modify) | Date 193#05/15/1979 (month day year) | Geohydrologic Unit 195#120FLRD

New Card Same R thru 195

Temperature	196#00010	Degrees C	197=24.	
Conductance	196#00095	µ Mhos	197=335.	
Other (STORET) Parameter	196#00400	Value	197=7.2	
Other (STORET) Parameter	196#00410	Value	197=4.45.	

	BY	DATE
CHECKED		
PUNCHED		
EDITED		
SUBMITTED		
VERIFIED		

FOOT NOTES:

①Source of Data Codes:

S D Ø A R L G Z (reporting agency, driller, owner, other gov't, other reported, logs, geologist, other)

WELL CONSTRUCTION DATA (1)

R = 58 * | T = A D (M) * (add, delete, modify) | Entry No 59 # 00.1 * | Date of Construction Completion 60 = 1 1 / 1 7 / 7 6 0 * (month / day / year) | Source of (1) Const. Data 64 = L *

Name of Contractor/Driller 63 = L A Y N E , A T L A N T * — Layne Atlantic

Method of Construction 65 = A B (C) D H J P R T V W Z *
(A air-, rotary; B bored, or augered; C cable-, tool; D dug; H hydraulic, rotary; J jetted; P air-par-, cussion; R reverse, rotary; T trenching; V driven; W drive, wash; Z other)

Finish 66 = C F G H Ø P S T W (X) Z *
(C porous, concrete; F gravel w, perf; G gravel, screen; H horizontal, gallery; Ø open, end; P perforated, or slotted; S screen; T sand point; W walled; X open, hole; Z other)

Type of Seal 67 = B C G Z *
(B bentonite; C clay; G cement, grout; Z other)

Bottom of Seal 68 = * | Method of Development 69 = A B C J N P S Z * (A air-lift, pump; B bailed; C compressed, air; J jetted; N none; P other, pump; S surged; Z other) | Number of Hours in Development 70 = *

Special Treatment During Development 71 = C D E F H M Z *
(C chemicals; D dry ice; E explosives; F deflocculent; H hydrofracturing; M mechanical; Z other)

DIMENSIONS OF THE HOLE CONSTRUCTED (2)

R = 72 * | T = (A) D M * (add, delete, modify) | Construction Entry No 59 # 00.1 *

New Card for Each Hole Segment Same R, T & Field 59

Top of Hole Segment Below LSD	Bottom of Hole Segment below LSD	Diameter of Hole Segment
73 # 0. *	74 = 366. *	75 = 12. *
73 # *	74 = *	75 = *
73 # *	74 = *	75 = *
73 # *	74 = *	75 = *
73 # *	74 = *	75 = *

CASING SCHEDULE (2)

R = 76 * | T = (A) D M * (add, delete, modify) | Construction Entry No 59 # 00.1 * | New Card for Each Casing With Same R, T & Field 59

Top of Casing Segment Below LSD	Bottom of Casing Segment Below LSD	Diameter of Casing Segment	Casing Material (5)	Thickness of Casing
77 # 2.0 *	78 = 116. *	79 # 12. *	80 = 1 *	81 = *
77 # *	78 = *	79 # *	80 = *	81 = *
77 # *	78 = *	79 # *	80 = *	81 = *
77 # *	78 = *	79 # *	80 = *	81 = *
77 # *	78 = *	79 # *	80 = *	81 = *

OPENINGS SCHEDULE (2)

R = 82 * | T = (A) D M * (add, delete, modify) | Construction Entry No 59 # 00.1 * | New Card for Each Open Section With Same R, T and Field 59

	(Openings Data)	(Openings Data)	(Openings Data)
Top of Section Below LSD	83 # 116. *	83 # *	83 # *
Bottom of Section Below LSD	84 = 366. *	84 = *	84 = *
Type of Openings (6)	85 = X *	85 = *	85 = *
Type of Material (7)	86 = *	86 = *	86 = *
Diameter of Open Section	87 = *	87 = *	87 = *
Width of Opening	88 = *	88 = *	88 = *
Length of Opening	89 = *	89 = *	89 = *

L-7

FOOT NOTES:

(1) Source of Data Codes:
S D Ø A R L G Z
(S reporting agency; D driller; Ø owner; A other gov't. reported; R logs; L geologist; G other; Z other)

(5) Casing Material Codes
B C G I M P R S T U W Z
(B brick; C concrete; G galv. iron; I wrought iron; M other metal; P PVC or plastic; R rock or stone; S steel; T tile; U coated steel; W wood; Z other)

(6) Type of Openings Codes
F L M P R S T W X Z
(F fracture; L louvered, shuttered; M mesh; P perforated, or slotted; R wire-wound; S screen, (unknown); T sand point; W walled; X open hole; Z other)

(7) Type of Material Codes for Open Sections
B C G I M P R S T Z
(B brass or bronze; C concrete; G galv. iron; I wrought iron; M other metal; P PVC or plastic; R stainless steel; S steel; T tile; Z other)

R = 134 146 * (flowing, pumped) T = A D M * (add, delete, modify) Entry No 147# 001 * Date 148 = 05/15/1979 * (month day year)

Discharge: 150 = 380.7 * Source of Data ① 151 = S *

Method of Measurement 152 = B C E F M O P R T U V W Z * (bailer, current meter, estimated, flume, totalizing meter, orifice, pitot-tube meter, reported, trajectory, venturi, volumetric, weir, other)

Production Level 153 = 36.89 * Static Level 154 = 33.12 * Source ① of Data 155 = S * Specific Capacity 272 = 101. *

Method of Measurement 156 = A C E G H L M R S T V Z * (airline, calibrated, estimated, pressure gage, calibrated pressure gage, geophysical logs, manometer, reported, steel tape, electric, calibrated electric tape, other) Pumping Period 157 = 3. *

LIFT DATA (1)

R = 42 * T = A D M * (add, delete, modify) Type of Lift 43# A B C J P R S T U Z * (air, bucket, centrifugal, jet, piston, rotary, submergible, turbine, unknown, other) Entry No 254 # *

Pump Intake Setting 44 = * Type of Power 45 = D E G H L N W Z * (diesel, electric, gasoline, hand, LP gas, natural gas, windmill, other)

Date 38 = / / * (month day year) Horsepower 46 = *

MAJOR PUMP DATA (2)

R = 47 * T = A D M * (add, delete, modify) Type of Lift 43# * Lift Entry No 254 # * Manufacturer of Pump 48 = *

Serial No of Pump 49 = * Name of Power Company 50 = *

Power Company Account No 51 = * Power Meter No 52 = * Pump Rating 53 = *

AVAILABLE LOG DATA (1)

R = 198 * T = A D M * (add, delete, modify) New Card for Each Log Type Same R & T

Type of Log ②	Begin Depth 200 =	End Depth 201 =	Source of Data ① 202 =
199# C *	100. *	366. *	S *
199# J *	2. *	360. *	S *
199# E *	200. *	364. *	S *
199# F *	3. *	360. *	S *
199# T *	30. *	360. *	S *
199# J *	2. *	140. *	S *
199# E *	100. *	360. *	S *
199# V *	100. *	345. *	S *

WATER QUALITY DATA COLLECTION (1)

R = 114 * T = A D M * (add, delete, modify) Begin Year 115# 1979 * End Year 116 = * Source Agency 117 = USGS *

Frequency of Collection ③ 118 = O * Network Site 257 = * Type of Analyses ④ 120 = M *

WATER LEVEL DATA COLLECTION (1)

R = 121 * T = A D M * (add, delete, modify) Begin Year 122# 197 * End Year 123 = * Source Agency 124 = USGS *

Frequency of Collection ③ 125 = * * Network Site 258 = *

WATER PUMPAGE/WITHDRAWAL DATA COLLECTION (1)

R = 127 * T = A D M * (add, delete, modify) Begin Year 128# 1979 * End Year 129 = * Source Agency 130 = USGS *

Frequency of Collection ③ 131 = O * Network Site 259 = * Method of Collection 133 = C E M U Z * (calculated, estimated, metered, unknown, other)

OTHER DATA AVAILABLE (1)

R = 180 * T = A D M * (add, delete, modify) Type of Data 181# * Loc 182 = C D Z * (cooperator, district, other) Format 261 = F M P Z * (files, machine, published, other readable)

New Card Same R & T Type of Data 181# * Loc 182 = C D Z * Format 261 = F M P Z *

FOOT NOTES:

① Source of Data Codes: S D Ø A R L G Z (reporting agency, driller, owner, other gov't, other reported, logs, geologist, other)

② Type of Log Codes: A B C D E F G H I J K L M N Ø P Q (time, collar, caliper, driller's, electric, fluid conduct, geologist, magnetic, induction, gamma ray, dipmeter, laterlog, microlog, neutron, μ later, photo, radio-active); S T U V Z (sonic, temp, gamma-gamma, fluid velocity, other)

③ Frequency of Collection Codes: A B C D F I M Ø Q S W Z (annual, bi-monthly, continuous, daily, semi monthly, intermittent, monthly, one time only, quarter annual, semi-annual, weekly, other)

④ Type of Quality Analyses Codes: A B C D E F G H J K L M Z (physical, common chemical, trace elements, pesticides, nutrients, sanitary, codes B&D, codes B&E, codes B&F, codes D&E, codes C,D&E, all or most, other)

Screen 4 of 7

GEOHYDROLOGIC UNIT DESCRIPTIONS (1)

R = 90 * | T = A D M * (add, delete, modify) | Entry No 256 # 001 * | Depth to Top 91 = 138. * | Depth to Bottom 92 = * |

Unit Identifier 93 = 120 FLRD * | Lithology 96 = LMSM * | Lithologic Modifier 97 = CAVERNOUS *

AQUIFER DATA (2)

R = 94 * | T = A D M * (add, delete, modify) | Geohydrologic Unit Entry No 256 # 001 *

Date 95 # 05/15/1979 * (month day year) | Water Level 126 = 33.12 * | % Water Contributed 132 = 95 *

GEOHYDROLOGIC UNIT DESCRIPTIONS (1)

R = 90 * | T = A D M * (add, delete, modify) | Entry No 256 # * | Depth to Top 91 = * | Depth to Bottom 92 = *

Unit Identifier 93 = * | Lithology 96 = * | Lithologic Modifier 97 = *

AQUIFER DATA (2)

R = 94 * | T = A D M * (add, delete, modify) | Geohydrologic Unit Entry No 256 # *

Date 95 # / / * (month day year) | Water Level 126 = * | % Water Contributed 132 = *

PERTINENT REMARKS

R = 183 * | T = A * (add)

185 = MINUTE MAID CO. - DR. PHILLIPS *

185 = MP = MANHOLE GRATE AT LSD *

New Card Same R&T

185 = DR. PHILLIPS *

311 #010 *

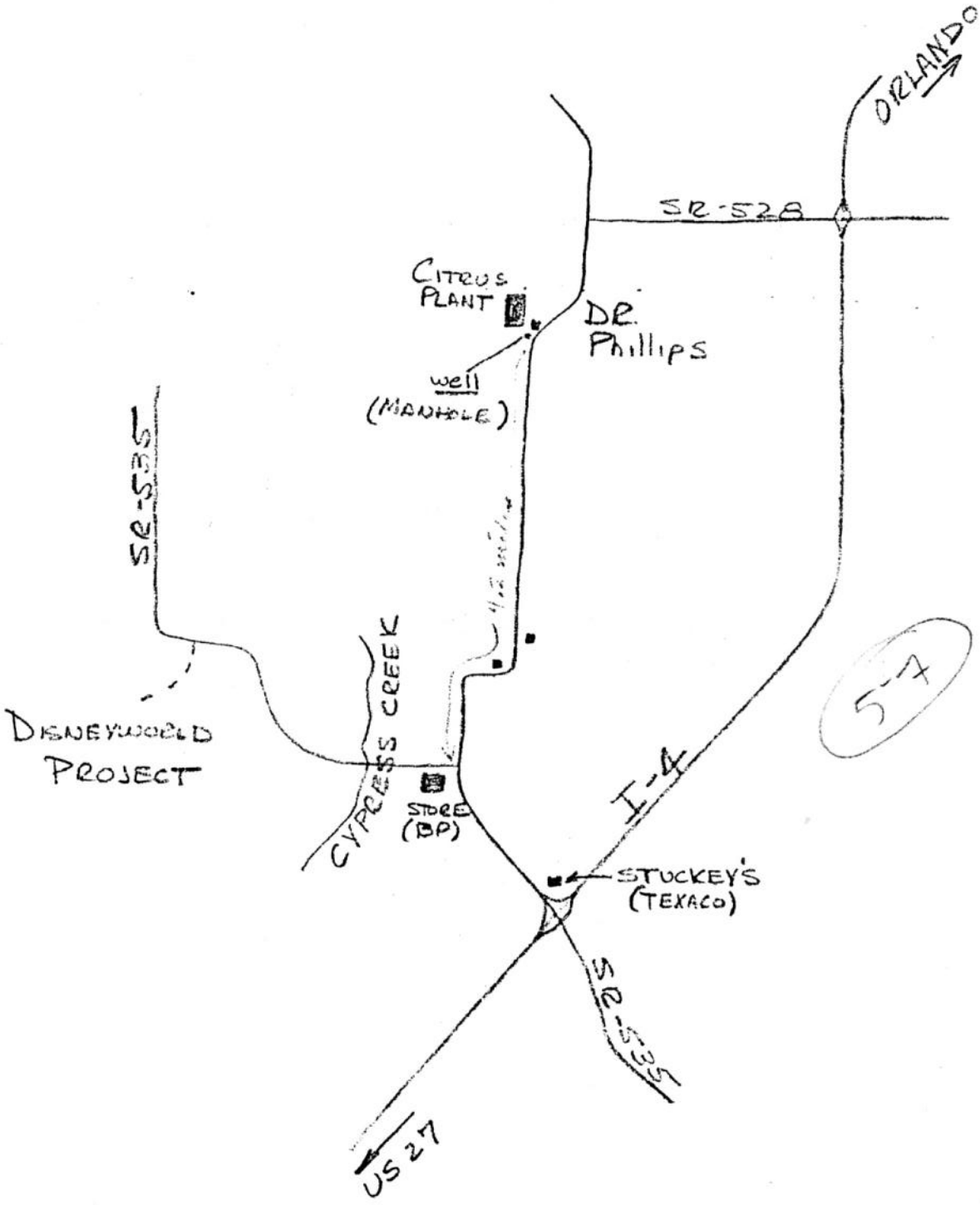
NOTES: 185 = YIELDING ZONES 120, 145 FT.

4-7

U. S. GOVERNMENT PRINTING OFFICE : 1976 O - 213-137

Screne 5 of 7

Dr. Phillips Deep (826-130-3)
282636 0813008



Layne 6-77

[DEP]ARTM[ENT] OF THE INTERIOR — GEOLOGICAL SURVEY

Water Resources Division Well Schedule Form

MASTER CARD

- [Rec]ord by: W.F LICHTLER — Source data: DRILLER — Date: 11-17-60 — Map: WINDERMERE
- [Sta]te: FLORIDA 09 — County (or town): ORANGE COUNTY 48
- [La]titude: 28 26 36 N — Longitude: 081 30 08 — Sequential number: 1
- [Lat]-long [acc]uracy: 1 — T 23 S R 29 E Sec 34 SW ¼ SE ¼ NW ¼
- Local [we]ll number: 826-130-03 — Other number:
- [Loc]al use: 223 BTES4 — Owner or name: MINUTE MAID
- [Ow]ner or name: MINUTE MAID CO. — Address: ORLANDO FLA
- [Ow]nership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist — N
- [Use] of [wa]ter: Air cond, Comm, Dewatering, Fire, Dom, Irr, Ind, P S, Stock, Instit, (U) Unused — U
- [Use] of [we]ll: (A) Anode, (D) Drain, (G) Seismic, (O) Obs, Oil-gas, (P) Recharge, (S) Spring, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed — D
- [DA]TA AVAILABLE: Well data 2 — Freq. W/L meas.: INTERMITTENT I — Field aquifer char.
- [Qua]l. lab. data:
- [Qua]l. water data; type:
- [Fre]q. sampling: — Pumpage inventory: yes no, period:
- [Ape]rture cards: yes
- [Log] data:

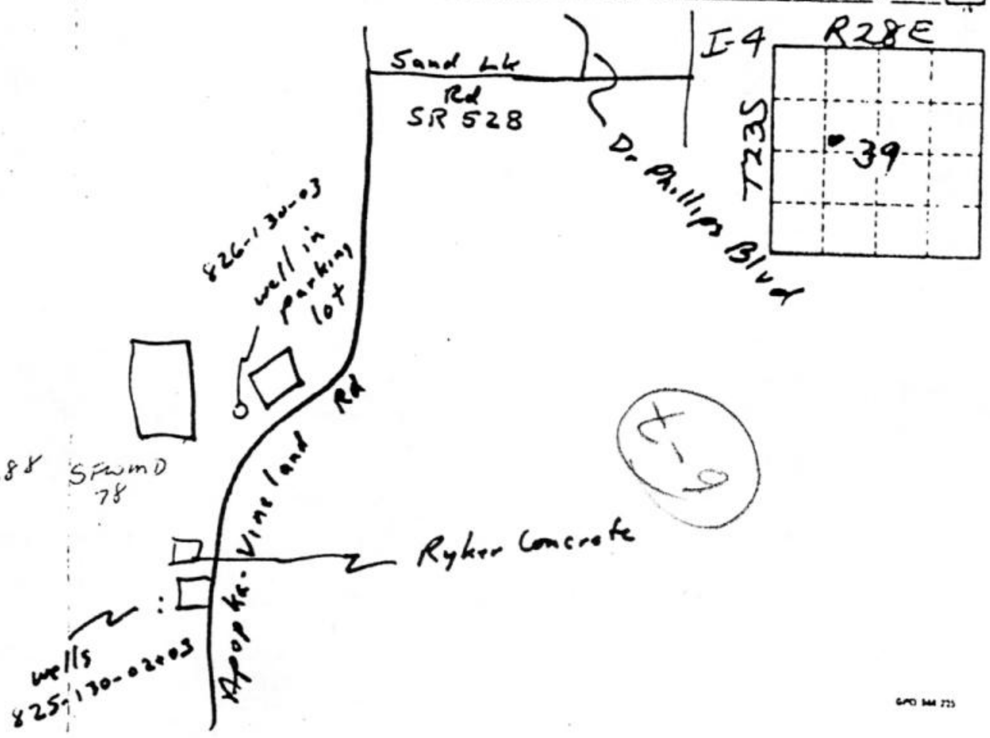
WELL-DESCRIPTION CARD

- SAME AS ON MASTER CARD — Depth well: 356 ft 356 — Meas./Rept. RPTD — Accuracy 6
- Depth cased; [To]tal perf.: 114 ft 114 — Casing type: BLK IRON — Diam. 12 in 12
- [Fin]ish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open end, (P) perf., (S) screen, (T) sd. pt., (W) shored, (X) open hole, (Z) other — X
- [Met]hod [dri]lled: (A) air rot., (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other — C
- [Date dri]lled: — Pump intake setting: ft
- [Dri]ller: LAYNE ATLANTIC — ORLANDO FLA
- [Lif]t (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple (cent.), (M) multiple (turb.), (N) none, (P) piston, (R) rot., (S) submerg, (T) turb, (Z) other — N — Deep / Shallow
- [Pow]er (type): diesel, elec, gas, gasoline, hand, gas, wind; H.P. — Trans. or meter no.
- [Desc]rip. MP: LIP OF MANHOLE AT LSD — ft above/below lsd. — Alt. MP: ~~106~~ 101.88 — SFWMD 78
- Alt. LSD: 101.88 ~~106~~ 106 — Accuracy (source): TOPO MAP 5FT 3
- [Wat]er [lev]el: 200.36 ft above/below MP; ft above/below lsd — 20 — Accuracy: TAPED 0
- [Dat]e: 11-17-60 — N60 — Yield: gpm — Method determined
- Drawdown: ft — Accuracy: — Pumping period: hrs
- [Qual]ity of [wat]er data: Iron ppm — Sulfate ppm — Chloride ppm — Hard. ppm
- Conduct. x 10⁶ — Temp. °F — Date sampled
- [Lo]gs, colors, etc.: 104

Well number: 28 26 36 081 30 [..]

HYDROGEOLOGIC CARD

- SAME AS ON MASTER CARD — Physiographic Province: COASTAL PLAIN 03 — Section: FLA. [...]
- SECT. C — Drainage Basin: — Subbasin:
- Type of well site: (D) local depression, (F) flat surface, (H) hilltop, (S) hillside, (T) terrace, (V) valley flat — F
- MAJOR AQUIFER: TERT[IARY] system — EOC[ENE] series — TE — FLORIDAN AQUIFER aquifer, formation, group — 1 F
- Lithology: CAVERN[OUS] LS. 04 — Origin: MARINE 6 — Aquifer Thickness:
- Length of well open to: 242 ft 242 — Depth to top of: 140 ft 140
- MINOR AQUIFER: system — series — aquifer, formation, group
- Lithology: — Origin: — Aquifer Thickness: ft
- Length of well open to: ft — Depth to top of: ft
- Intervals screened:
- Depth to consolidated rock: 140 ft 140 — Source of data: SUBSURFACE MAP L
- Depth to basement: 6600 ft 6600 — Source of data: DRILL LOG D
- Surficial material: F FINE SAND 25 — Infiltration characteristics: EXCELLENT 1
- Coefficient Trans: gpd/ft — Coefficient Storage:
- Coefficient Perm: gpd/ft² — Spec cap: gpm/ft; Number of geologic cards:



826-130-03

GPO 944 725

Selene Foy

WRD Rev. (CR)
Aug. 1964

U. S. DEPARTMENT OF THE INTERIOR — GEOLOGICAL SURVEY

Water Resources Division Well Schedule Form

MASTER CARD

Record by: W.F. LICHTLER, DRILLER — Date: 11-17-60 — Map: WINDERMERE

State: FLORIDA [09] — County (or town): ORANGE COUNTY [095]

Latitude: 282626 N — Longitude: 0812800 W — Sequential number: 1

Lat-long accuracy: 1 — 23 S — 28 E — sec 34 — SW 1/4 SE 1/4 NW 1/4

Local well number: 826-130-03 — Other number:

Local use: 223 BIE531 — Owner or name: MINUTE MAID

Owner or name: MINUTE MAID CO. — Address: ORLANDO FLA

Ownership: County, Fed Gov't, City, (Corp or Co), Private, State Agency, Water Dist — M

Use of water: Air cond, Comm, Dewatering, Fire, Dom, Irr, Ind, P S, Stock, Instit, (Unused) — U

Use of well: Anode, (Drain), Seismic, Obs, Oil-gas, Recharge, Spring, Test, Unused, Withdrawal, Waste, Destroyed — D

DATA AVAILABLE: Well data [Z] — Freq. W/L meas.: INTERMITTENT [I] — Field aquifer char.

Hyd. lab. data:

Qual. water data: type:

Freq. sampling: — Pumpage inventory: no, period:

Aperture cards:

Log data:

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD — Depth well: 356 ft [356] — Meas./Rept.: RPTD — accuracy — 6

Depth cased: 114 ft [114] — Casing type: BLK IRON — Diam. 12 in — 12

Finish: porous concrete, gravel w. (perf.), gravel w. (screen), horiz. gallery, open end, perf., screen, sd. pt., shored, (open hole), other — X

Method Drilled: air, bored, (cable), dug, hyd jetted, hyd rot., air percussion, rotary, reverse trenching, driven, drive wash, other — C

Date Drilled: — Pump intake setting: ft

Driller: LAYNE ATLANTIC ORLANDO FLA

Lift (type): air, bucket, cent, jet, multiple (cent.), multiple (turb.), (none), piston, rot, submerg, turb, other — N — Deep / Shallow

Power (type): diesel, elec, gas, gasoline, hand, gas, wind; H.P. — Descr. of meter no.

Descrip. MP: LIP OF MANHOLE AT LSD — ft above/below LSD; Alt. MP: ~~106~~ 101.88

Alt. LSD: 101.88 ~~106~~ [106] — Accuracy: TOPO MAP 5FT — 3

Water level: 20.26 ft above/(below) LSD [20] — Accuracy: TAPED — O

Date meas.: 11-17-60 [N60] — Yield: gpm — Method determined:

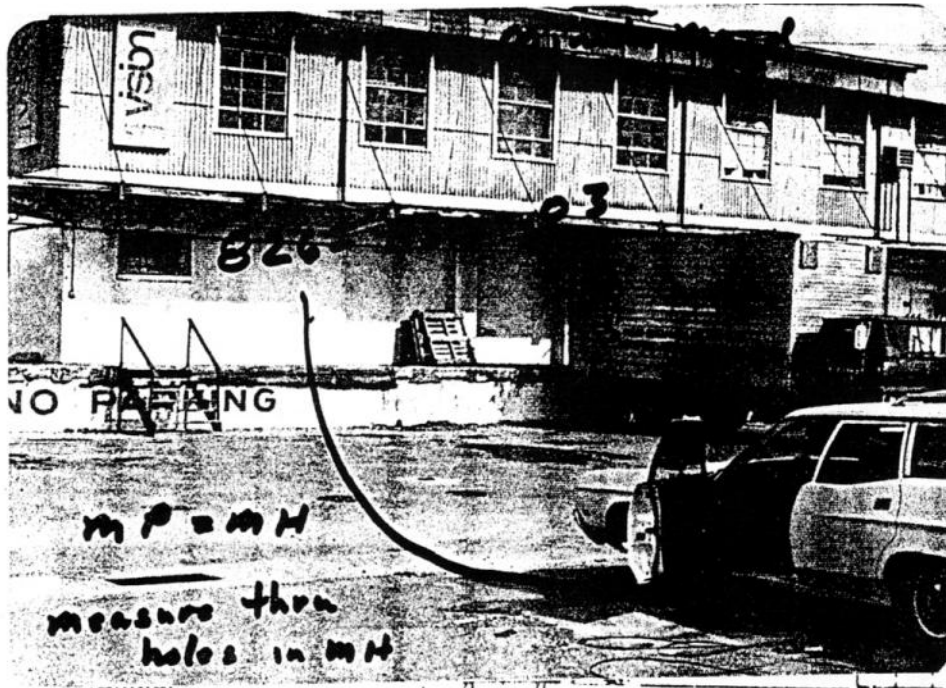
Drawdown: ft — Accuracy: — Pumping period: hrs

Quality of water data: Iron ppm — Sulfate ppm — Chloride ppm — Hard. ppm

Sp. Conduct. K x 10⁶ — Temp. °F — Date sampled

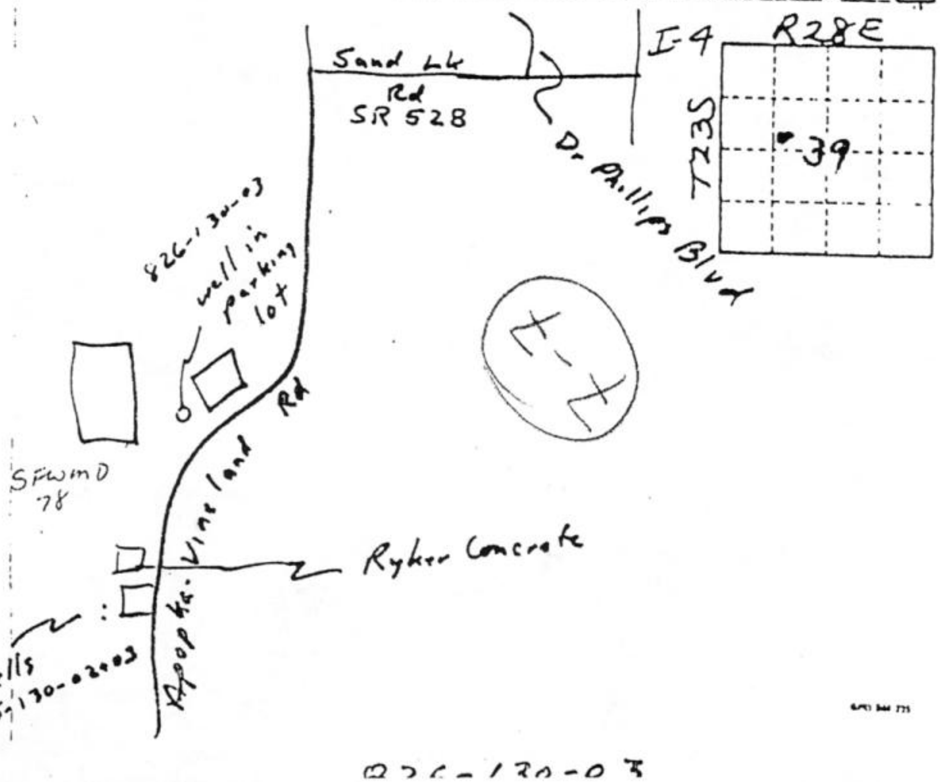
Taste, color, etc.

10,Ⓖ



8-1

Specific capacity: gpd/ft; Spec cap: gpm/ft; Number of geologic cards:



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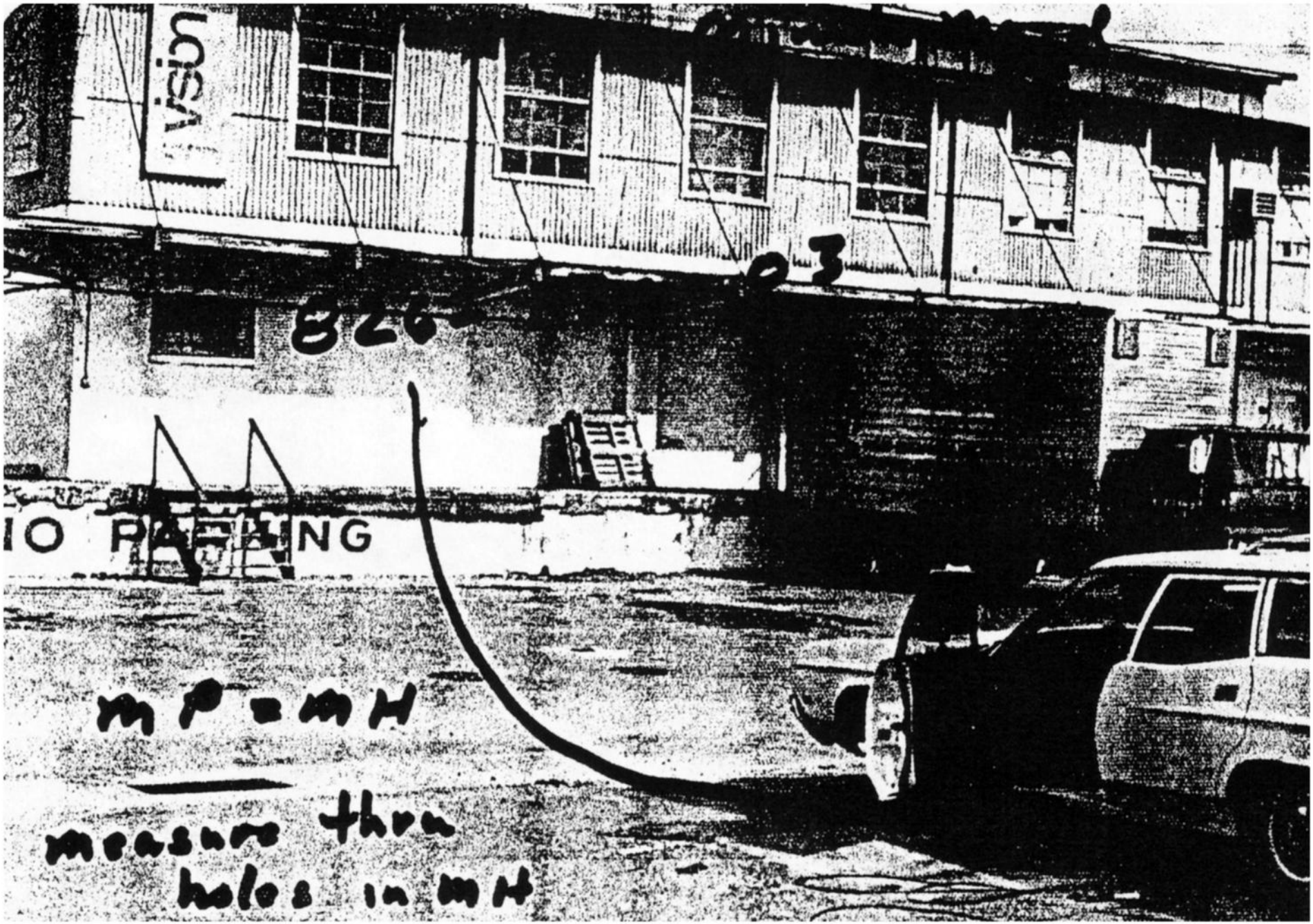
826
NO PARKING
MP-MH
measure thru
holes in MH

SFWMD DRAINAGE WELL INVENTORY

Location

Apopka-Vineland Roa \ Sandlake Road

south of Sandlake, in S-curve,former Minute-Mai

Alternate IDs

City N/A
County N/A
District 1494053494574
USGS 282636081300801

Access Requirements

N/A N/A

Handheld Coordinates

Northing	*Easting*
1494052.9	494574.5

LOCATION MAP

WELL SKETCH

NO WELL SKETCH AVAILABLE

WELL PHOTOGRAPH

No. of Inlets 9999

Inlet type: N/A
Inlet elevation: 9999 ft

Inlet type: N/A
Inlet elevation: 9999 ft

Inlet type: N/A
Inlet elevation: 9999 ft

Casing/Well Information

9999 or N/A indicates that data is unavailable.

Construction Date:	9999
Casing diameter (in)	12
Casing depth (ft)	114
Total depth (ft)	356
Manhole Elev. (ft)	9999
Depth to water:	9999
Water Quality:	N/A

Well Status: lost
Drainage source: street
Major basin: Shingle Creek
Basin size (ac): 70715.33
Video log: No
Geophysical log: No

Hartman & Associates, Inc.


34
1958


34
1969


1975


1984


1994


1997

ATTACHMENT C
NEWSPAPER ARTICLES ON HIGH WATER IN BIG SAND LAKE

As Lakes Pour Over Banks, Homeowners' Worries Rise

In Orange County's Sand Lake Basin And Elsewhere, Soggy Skies Are A Serious Matter.

August 20, 2003 | By Melissa Harris, Sentinel Staff Writer

Two months into the project, Victoria and Roger Berry realized that landscaping the back yard of their new home on Big Sand Lake in southwest Orange County was becoming pointless.

The lake was swallowing their boat dock and most of their back yard, swelling nearer to their screened-in pool.

"It scares me," Victoria Berry, 51, said Tuesday, remembering a flood in Houston that forced her to replace the insulation in her house. "There's nothing you can do about it but watch."

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September 28, 2004

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October 20, 2005

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September 25, 2004

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Once suffocating from drought, thousands of lakeshore dwellers across Central Florida are living in fear of rising water, acquiring sandbags and, in some cases, evacuating homes.

Even though the water isn't expected to make it inside the Berrys' home -- or those of their neighbors -- problems in the 5,000-acre Big Sand Lake basin have become so severe that Orange County has hired a consultant to figure out a long-term solution.

The National Weather Service predicts more rain this week in Central Florida. Orlando has been deluged with 7.54 inches of rain this month, almost double the normal amount.

Heavy rainfall has caused Big Sand Lake to rise 9 feet in one year, while Lake County officials are recording the most rainfall since they began measuring about 110 years ago.

"We're extremely vulnerable because we're not through with the rainy season," said Ron Hart, a water-resource planner with the Lake County Water Authority.

Hart says that earlier in the year his authority could open up dams gradually to prevent flooding. But now the dams are wide open, leaving few opportunities for relief.

In Osceola County, sections of Poinciana Boulevard and Osceola Parkway flooded during Tuesday's

Lake County

Flooding

Osceola Parkway

thunderstorms, and county officials planned to put up signs warning motorists of the high waters, authorities said Tuesday night.

Residents in the Crescent Lakes neighborhood off Poinciana Boulevard were complaining of up to 6 inches of water on their property, county spokeswoman Twis Hoang said. Meanwhile, two dirt streets in rural Intercession City had to be closed because of flooding, Hoang said.

"The ground is saturated," she said. "It's just a lot of water in a short period of time."

There were no reports of flooding inside homes, Hoang said, although the water got close in some spots. Flooding on Osceola Parkway near Florida's Turnpike in Buenaventura Lakes is a frequent problem, and the county is studying how to alleviate it.

At Big Sand Lake, water burst through a makeshift dam a week and a half ago, sending water from neighboring Little Sand Lake pouring into the Berrys' back yard.

Workers are trying to unclog the water's only escape route, which involves a series of ditches and pipes, some of which are filled with dirt from the widening of Interstate 4 near the Central Florida Parkway.

As of mid-afternoon Tuesday, water in the pipeline was trickling in the wrong direction -- back toward the lake.

"We didn't know about it because maintenance doesn't regularly patrol it," said Steve Homan, spokesman for the Florida Department of Transportation. "Getting this fixed by Wednesday evening is our best-case scenario."

Orange County Commissioner Teresa Jacobs discovered the blockage while inspecting the site more than a week ago. Once the transportation department clears the pipes, Jacobs wants the South Florida Water Management District, which permitted the faulty sea wall around the dam about three years ago, to speed up the recovery process by pumping water out of the lake.

For the most part, homeowners are trying to remain calm, joking about their dead trees, submerged flower pots and benches, and unreachable boats. Most haven't begun to assess the damage.

Dale Harden, a retired engineer and member of the Big Sand Lake Advisory Board, measures the lake level every morning, standing in thigh-deep water on top of his boat dock.

"This isn't a crisis, but we need to get the system unclogged or we'll have dangerously high levels of water," Harden said.

Phil and Lisa Ciarlo, however, are not as calm.

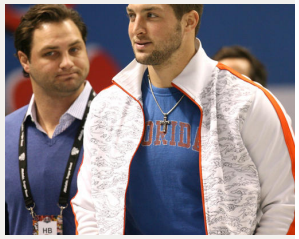
Water is lapping up against the concrete base of their screened-in pool. They hired contractors to build a barrier around the back of their house, which will be filled in with sand to prevent any erosion under their pool and patio.

"I have been watching this disaster brew for the past six months," Phil Ciarlo wrote in a letter to Jacobs last week. "Unfortunately, I can't seem to get anyone to take action. The people who are responsible are either doing a study, contacting other departments or consulting with someone."

Featured Articles

Auction set for Warren Sapp's Windermere home

Great foreclosure deals in Orlando grow scarce



If NFL won't give Tebow a chance, Orlando Predators will

MORE:

Floods Follow Frances' Deluge

Residents Across Central Florida See Their Yards Fill With Water.

September 8, 2004 | By Sandra Pedicini and Jim Leusner, Sentinel Staff Writers

As Seminole County waited for the St. Johns River to crest in Sanford, homeowners throughout Central Florida saw their yards slowly fill with water from Hurricane Frances.

Officials from the National Weather Service said the St. Johns -- which drains the eastern half of Central Florida -- reached flood stage at Lake Harney on Tuesday and will flood at Sanford by tonight. Seminole County warned residents to consider evacuating low-lying areas.

Flowing at more than 4 million gallons a minute in some places, the St. Johns has risen almost 2 feet at Lake Harney since Sunday and more than 18 inches in Sanford, where the city issued a formal flood warning Tuesday. Although Sanford officials say it is unlikely water from Lake Monroe will come over the sea wall, the rise in the lake level could overwhelm its stormwater system.

Throughout the region, rivers, lakes and canals continued to swell, but flooding was isolated and mostly confined to low-lying roads and waterfront homes.

In Polk County, up to 20 homes in Peace River Estates No. 1 east of Bartow were flooded Tuesday by the Peace Creek, said Jeff Spence, Polk Natural Resources director.

In Volusia County, hard-hit areas such as Port Orange saw street flooding recede from a high of 4 feet to 2 feet. The city, overwhelmed by water from retention ponds, canals and creeks feeding into Spruce Creek, had flooding aggravated by a sewage spill from a pumping-station power failure.

In Port Orange's Cambridge neighborhood, several residents traveled down the street by canoe. One resident posted a sign reading: "Please, No Wake!"

In Ocoee in west Orange County, an eastbound lane of State Road 50 was closed because of 2 feet of water spilling from a pond, police Sgt. Randy Conyers said. Traffic backed up for 11/2 miles. The water was pumped out of the roadway by late afternoon, but the lane remained closed.

Along Big Sand Lake in Orlando's Dr. Phillips area, water stood 2 feet deep in the back yards of million-

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Lake Harney residents brace for flooding
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Water

Flooding

dollar homes. "Here we go again," said Phillips Landing resident Phil Ciarlo, who has complained for a year that broken lake berms have led to flooding.

In Osceola County, Poinciana Boulevard was closed from Reaves Road south to Pleasant Hill Road because of water damage. The road may be closed for up to 48 hours.

In Lake County, emergency officials were bracing for flooding along the St. Johns near Astor, where some neighborhood streets already are inundated and may be evacuated. Mascotte, Groveland and south Sumter County also are battling huge amounts of water flowing out of the Green Swamp.

Seminole County sent out reverse 911 calls on Tuesday to about 2,000 residents in low-lying areas, including Geneva, near Lake Harney, suggesting they prepare for a voluntary evacuation.

Larry and Denise Barnett, who live on Retreat Road west of Lake Harney, got one of the calls. The road was flooded so badly that some residents couldn't get out in their cars. Barnett has been able to get through the waters in his truck.

"It's going to get worse," Larry Barnett said. "It's going to be a wait-and-see kind of thing."

Lena Holton didn't want to bring her Ford Taurus through the water -- "It would be halfway up the doors." So to get her 8-year-old daughter Kayla to the doctor, she walked up to Mullet Lake Park Road and waited for a friend to pick her up.

The county closed Mullet Lake Park after floodwaters covered a boat ramp and part of the road. Seminole and Volusia counties also sought state authority to establish no-wake zones in the area to limit damage to homes that have rising water near them and to prevent boaters from hitting submerged docks.

The St. Johns River Water Management District was doing what it could to minimize flooding. Spokesman Hank Largin said the district was bleeding water out of the river system in Palm Bay and Lake Apopka. But that will not prevent flooding, he said.

"It's like there's asphalt everywhere. The ground is so saturated, the water just runs off very fast," he said.

Despite the rising waters, not many people were stopping to pick up sandbags given out in two Seminole County locations Tuesday. Residents could take up to 30 bags per vehicle.

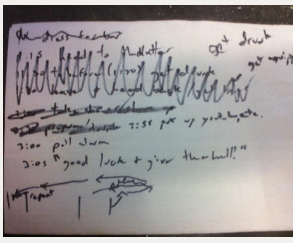
It was too late for one of the parks-department workers handing out the sandbags. Earl Dawson, who lives near Lake Harney in Geneva, said his yard was already flooded.

"I just park at the road and wade to my house," he said.

Featured Articles

Auction set for Warren Sapp's Windermere home

Great foreclosure deals in Orlando grow scarce



911 call: 'My roommate ... he's there with ... some ... large assault gun'

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HURRICANE FRANCES | AFTERMATH

Waters Rise On Elderly

At Good Samaritan Village, Residents Evacuate To Escape Swollen Shingle Creek.

September 11, 2004 | By Susan Jacobson, Sentinel Staff Writer

KISSIMMEE -- Hundreds of elderly residents of Good Samaritan Village have been forced to flee in the wake of post-hurricane flooding that caused sewage and storm water to back up into the streets and some homes.

Friday, Lynx buses helped move 161 nursing-home and assisted-living residents to Horizon Middle School, where the gym was converted into a makeshift health-care center complete with medical personnel and dietary staff. Osceola County firefighters and volunteers with trucks helped transfer equipment and materials, said John Kroom, disaster chairman for Good Samaritan Village.

"We are going to run that shelter as if it was our nursing home," Kroom said.

Between 200 and 250 independent-living residents who couldn't find temporary lodging spent Thursday night at Osceola Heritage Park exposition hall. About 100 of them were being moved Friday to Trinity Lutheran Church in Kissimmee because of crowding.

Margaret Stevens, 88, slept on a cot Thursday night in the lobby of the exposition hall.

"We have no family we can go to," said Stevens, a childless widow who is recovering from a broken ankle and relies on a walker.

Other people passed the time doing jigsaw puzzles, singing or watching TV.

In a large room filled with cots, a conga line formed as Ruth Lord, 87, played keyboard. Her biggest worry? Her cat, Lady, was in a shelter at Good Samaritan Village.

"I hate to leave her, but I guess she's in good hands," said Lord as she paused during a rendition of "Mares Eat Oats (Mairzy Dotes)."

The 435-acre Good Samaritan campus is home to more than 1,500 people, according to its Web site. The average age is 80, Kroom said.

No firm figure was available Friday on the number of people who were evacuated because some are seasonal residents who are out of state at their summer homes.

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Residents of hundreds of apartments and manufactured homes were asked to leave Thursday, Kroom said. They won't be able to return home for at least five days -- perhaps longer if Hurricane Ivan dumps more rain on Central Florida.

The problem is Shingle Creek, which is so swollen after Hurricane Frances that it is flooding Good Samaritan Village. Several streets were impassable Friday, and fences and yards were inundated in some sections. The golf course was under water.

The village's sewage-treatment plant couldn't function properly because the place is so waterlogged. That led to a sewage backup and a foul smell in some areas.

Several dozen manufactured homes are flooded or in danger of flooding, employees said. It won't be known how long cleanup efforts will take until residents and workers can assess the damage.

Standing water poses an additional hazard when it comes into contact with electrical transformers, Kissimmee Utility Authority spokesman Chris Gent said. KUA had to turn off power to part of Good Samaritan Village because of the danger of electrocution, he said.

The South Florida Water Management District is moving water out as fast as possible, spokesman Bill Graf said, but it could take up to two dry weeks before Shingle Creek is back to normal. Runoff from Orlando drains into the creek, which empties into brimming Lake Tohopekaliga, which has only one outlet to the Kissimmee River.

"All the rainfall in that area is going to end up by Good Samaritan," Graf said.

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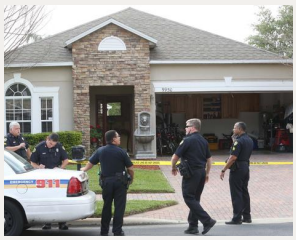

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Residents Hope Well Helps Drain Flooded Lakeside

September 20, 2004 | By Beth Kassab, Sentinel Staff Writer

It sounds like the kind of simplistic solution dreamed up in a cartoon world: County workers plan to drill a hole in the ground and drain Big Sand Lake like an overflowing bathtub.

"Is that really what they're going to do?" asked Matt Durfee, whose back yard on the lake, like many of his neighbors', is flooded. "It almost sounds like something out of Bugs Bunny."

Though more complicated in reality, the state Department of Environmental Protection has given the go-ahead for Orange County to dig a drainage well for Big Sand Lake, which after hurricanes Charley and Frances has swallowed every dock, boathouse and back yard on its perimeter.

For Durfee and his wife, Irma Moreno, the damage is even worse. Their pool patio is perched at the water's edge, with cracks so severe it looks as if it could crumble into the lake at any moment.

"More than a hurricane, it looks like an earthquake," Moreno said of the damage from waves spurred by hurricane-force winds.

Permission for the well, which came after months of lobbying by residents, is welcome relief this week for her and others on the lakefront where many homes are valued near or more than $1 million in the Dr. Phillips area of southwest Orange County.

Flooding problems there predate Charley and Frances. Last year, the water line reached nearly 98 feet above sea level -- a foot higher than it is now -- as a result of heavy rains and a berm that broke between Big and Little Sand lakes.

The county used pumps to take out about 3 feet of water from the lake last year and asked the DEP for permission to drill a drainage well last May, but was denied.

New wells are rarely approved by the DEP because they feed directly into the underground aquifer, risking contamination to the state's drinking-water supply.

But county officials were able to point to a U.S. Geological Survey that shows a drainage well already

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exists somewhere on Big Sand Lake -- likely dating from the 1930s -- though it's no longer functioning and its exact location is not known.

After the hurricanes, residents and County Commissioner Teresa Jacobs lobbied state environmental officials to reconsider their decision. Last week, Jacobs sent out a memo alerting residents of the "good news."

The department gave "verbal permission" for the county to drill a replacement well based on "unprecedented weather in Central Florida," DEP spokesman Jeff Prather wrote in a statement.

Prather said the department has approved maintenance to about 65 drainage wells in Central Florida in recent years.

Test wells are being drilled near the lake this week to determine the placement and depth for the well, said M. Krishnamurthy, manager of the county's stormwater management division. The county is expected to split the estimated $200,000 cost of the project with the South Florida River Water Management District.

He said residents on the lake will notice the water gradually returning to a more-normal level, likely between 90 and 92 feet.

"It will definitely give flood protection," he said. "It takes some time. They will see it slowly."

During the past 15 years, developments along the lake such as Vizcaya, Phillips Landing and Bay Vista Estates were built under the condition that the shoreline would remain about 90 feet above sea level.

Some people there think new developments worsened the flooding problem.

"There's conflicting opinions on that," said John Jennings, chairman of the Big Sand Lake Advisory Board. "I'm sure if there was nothing built on those 5,000 acres, it would be a lot different than it is now."

Dale Harden, who lives in Phillips Landing near Moreno and Durfee, has lost his dock and landscaping to floodwaters. Harden, a retired engineer who has monitored lake levels, would like to see water pumped away again this year, but officials have denied that request because it would exacerbate flooding downstream at Shingle Creek.

That means he and his neighbors are in for a monthslong wait to see the water recede after the well is drilled.

"It's over my kneecaps," Harden said of his back yard. "And it's still going up with every little rainfall."

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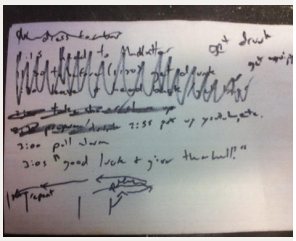

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High Water Imperils Homes, Roadways

Neighborhoods Turn Into Islands As Region's Rivers, Lakes Overflow

September 28, 2004 | By Kevin Spear, Sentinel Staff Writer

In southwest Orange County, a small lake overflowed with Hurricane Jeanne's runoff to block Darlene Drive. Drainage workers had no easy way to move floodwaters off the neighborhood street.

In east Seminole County, the Little Econlockhatchee River rose a dozen feet to engulf yards, leaving residents with a tedious wait for lower levels.

Elsewhere across Central Florida were hundreds more examples of local flooding in the wake of Hurricane Jeanne.

Contributing causes varied from clogged storm drains to the region's flat terrain.

"Take a dinner plate and put water on it, and that's us," said Ron Ribaric, an Orange County public-works project manager.

Among those aware of flat geography is Virginia Fanslow, 73, of Belle Isle. Stormwater on the road in front of her home lapped at hubcaps.

"That's Lake Fanslow," she said, adding that Lake Conway behind her home is rising.

Flooding along the St. Johns River and the Kissimmee River -- the region's two biggest drainage basins -- is expected to worsen through next week.

In a series of related flood woes, Orange County resorted to pumping water off Darlene Drive near the Dr. Phillips neighborhood into a retention pond.

"What you've got to understand is all that water goes to Big Sand Lake," said Deodat Budhu, manager for the county's drainage division.

Big Sand Lake, already flooding yards and pools, is spilling into Shingle Creek.

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Downstream in Osceola County, Shingle Creek, unable to flow into the swollen Kissimmee River, has backed into the retirement complex of Good Samaritan Village.

Kissimmee Utility Authority reported Monday that it had to cut power to 98 transformers feeding underground electricity to 750 village customers.

In Ocoee, water spilled out of Lake Bennet to block portions of State Road 50.

"We've had problems there in the past but nothing quite this bad," said Alan Hyman, district maintenance engineer for the state Department of Transportation.

In DeBary, local flooding turned homes in the Glen Abbey subdivision into islands on Monday. Residents rented trucks to haul away furniture as they blamed runoff from neighboring-subdivision Saxon Woods for aggravating high-water troubles.

In Deltona, motorists Monday had to navigate roadways turned to waterways at Tivoli Drive and Wheeling Avenue, along Catalina Boulevard and Prescott Boulevard at India Boulevard.

In Sanford, streets were impassable in the Lincoln Heights subdivision, while State Road 46 between Mellonville and Summerlin avenues was closed.

And in the Lake County city of Mascotte, already soggy from the earlier hurricanes, 4 feet of water inundated Laurel Street.

"It merely added insult to injury," City Manager Glenn Irby said.

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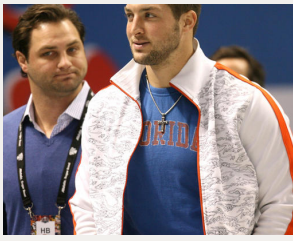

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Asking To Be High And Dry

At The Urging Of Dr. Phillips-area Residents, The Orange County Commission Will Ask The State's Permission To Pump Water Out Of Big Sand Lake.

January 6, 2005 | By Beth Kassab, Sentinel Staff Writer

As water continues to lap over boat docks, sink lawn furniture and crack the cement walls that protect swimming pools, people who live on Big Sand Lake are asking: When will it reach our homes?

Though the water has not intruded inside the million-dollar houses that surround the lake in the Dr. Phillips neighborhood, the Orange County Commission voted this week to break from its usual policy and ask the state for permission to pump water out of the lake.

Typically the county doesn't endorse pumping unless there is an "eminent threat to life, health and safety."

But residents are growing impatient, and officials cited environmental concerns -- such as runoff pollution and vegetation projects that have been on hold because of high-water levels -- as reasons to pump the lake sooner rather than later. The lake level is at 97 feet, about 7 feet higher than what is considered the normal high elevation for Big Sand Lake.

"Nobody cared if we lost our back yards or our docks," said John Jennings, who lives on the lake in Bay Vista Estates. "They said, `Those rich guys? Who cares?' Now we're starting to get structural damage to our homes."

Jennings, chairman of the county's Big Sand Lake Advisory Board, said he's worried waves generated by last year's hurricanes and other smaller storms have compromised the foundations of homes. At least one house in the Phillips Landing subdivision already lost its pool into the lake.

As he drove around the lake earlier this week, he pointed out cracking or drowned seawalls, the rooftops of boathouses that barely peek out of the water and -- possibly one of the biggest problems for the lake -- a broken dam that once seperated Big Sand Lake from Little Sand Lake.

When it broke about two years ago, water rushed from Little Sand Lake into the larger lake. As

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development dramatically increased over the past 10 years, Big Sand Lake also became the outlet for other nearby smaller lakes that were affected by paved streets and homes.

The South Florida Water Management District turned down requests to pump water out of the lake just months ago because it would have caused flooding downstream in the already-overflowing Shingle Creek area.

As the state moves into its dry season, those concerns are no longer an issue, and the request will likely be approved this time around, said district spokesman Bill Graf.

"We're not shifting problems to anybody, we're alleviating a problem, and the downstream community won't notice any perceptible difference," he said.

County officials are concerned that the decision may cause other lakes with high water levels, such as the Butler and Winter Park chains, to request pumping permits as well -- a trend the county doesn't want to start.

"I think there are very sound reasons to treat this lake at this point in time differently," said County Commissioner Teresa Jacobs, citing concerns about potential pollution.

Residents of the lakefront neighborhoods will pay the $100,000 cost of the pumping out of a special tax collected from businesses and residents with lake access.

Jennings and other residents lobbied Gov. Jeb Bush for permission to pump the lake and for a second drainage well to be built in the lake.

In September, the county received state approval for one drainage well -- controversial because it siphons lake water into the underground drinking water supply. The project is a slow remedy to the problem, though, likely lowering the water level by less than a foot each year.

When the water management district allowed the county an emergency pumping permit in 2003, the water level fell about 2 feet in three months.

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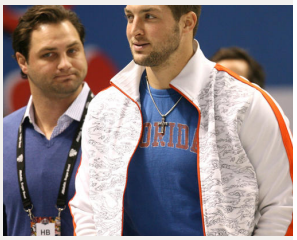

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What Happens To The Water?

Drainage wells' impact unknown

A flood of pollution hasn't yet ruined our drinking water. Experts ask why.

June 18, 2005 | By Beth Kassab and Kevin Spear, Sentinel Staff Writers

With every thunderstorm, a stew of dog waste, automobile chemicals, yard pesticides and other impurities washes into street gutters, down hundreds of wells and eventually into Central Florida's drinking-water supply.

That may not be as dangerous as it sounds, according to early results from a first-of-its-kind study on what happens when pollutants plunge underground.

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"We're a little surprised we are not finding more bacterial contamination," said Jim Gross, a project manager from the St. Johns River Water Management District in Palatka. "We're not sure what's going on chemically or biologically."

Through this summer, scientists will take the most sophisticated look yet at whether drainage wells will eventually ruin the area's drinking water or are, in fact, supplying an unexpected benefit to its long-term future.

Gross said initial findings suggest that although the gunk that flows into drainage wells is a far cry from the water that people would consider using in their homes, it's eventually cleansed by microscopic bugs, filtered by the Floridan Aquifer's porous limestone or neutralized by little understood chemical reactions.

Or it might be that the analysis, focusing on a few of the area's 487 drainage wells, doesn't offer a complete picture.

"Anything that lets contamination into the aquifer could be a problem," said Trudy Phelps, a U.S. Geological Survey hydrologist in Altamonte Springs who isn't part of the study. "You need to be really careful."

CRITICAL IN EASING FLOODING

Drinking Water

Drainage

Flooding

Aquifer

Drainage wells have been used for decades in urban Orange County and elsewhere in Central Florida to keep streets and yards from flooding, a critical role this year, as 28 inches of rain has already fallen in Orlando -- about 10 inches more than normal.

In the 1980s, however, the wells were suspected of posing so much danger to the pristine aquifer, the layers of limestone caverns that store the region's drinking water, that federal authorities banned new ones.

A decade ago, however, state regulators slowly began to allow aging drainage wells to be replaced -- perpetuating the century-old method of using enormous straws to funnel untreated water hundreds of feet into the earth. At the time, experts were beginning to understand that drainage wells play a significant part in refilling the aquifer, which could eventually run short of water without them.

Yet nobody claimed to understand the aquifer's plumbing well enough to explain the whereabouts of the contaminants brought in by drainage wells.

During the eons of its creation, the limestone aquifer was mottled by cracks, tunnels and holes that carry water in all directions.

"It's an unbelievably complex system with fractures and things like that that we can't see from the ground," said Phelps of the U.S. Geological Survey.

David Kincaid, a Devo Engineering hydrogeologist, is overseeing the drilling of replacement wells at Lake Sherwood near Ocoee.

The depth of drilling, he said, is guided by finding a cavern or tunnel -- an underground river, essentially -- that can swiftly whisk away the water and contaminants that flow down the wells.

"I've seen them big enough to drive a Mack truck through," Kincaid said.

TACKLING BIG SAND LAKE

Though scientists aren't exactly sure what happens to the dirty water, people continue to rely on the wells as the first line of defense against flooding.

John Jennings and his neighbors on Big Sand Lake saw some relief after a well drilled nearly 70 years ago was fixed last year after state officials first denied the permit. The lake had swallowed every dock and backyard on its shoreline by the time the third hurricane blew through town last fall.

But the drain well is only operating at about half-efficiency because of a mechanical glitch, Jennings said, and pumps have been needed to keep the water level containable.

"It helps, but is it solving the problem? A little bit," said Jennings, chairman of the Big Sand Lake Advisory Board.

The board's permit to pump water out of the lake and into Shingle Creek expired last week, so now residents are relying solely on the well to lower the water level as the wettest part of the year approaches. Efforts for officials to approve a second well have stalled, he said.

"Right now we're in a crisis situation," Jennings said.

By the 1990s, water experts had calculated that the region would face another kind of crisis.

The Orlando area was pumping up nearly all the drinking water that the aquifer could safely offer -- about 600 million gallons daily -- while drainage wells were refilling the aquifer with as much as 50 million gallons a day.

Environmental regulators have hoped that the extraordinary depth of the pipes that bring drinking water to the surface is what has protected them from contaminants deposited at a shallower level by drainage wells.

For the most part, drainage wells don't extend deeper than 400 feet, while drinking-water wells often exceed 1,000 feet below the surface.

100 YEARS' WORTH OF GUNK

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Already full, lakes may face deluge

October 20, 2005 | By Sandra Pedicini and Elaine Aradillas, Sentinel Staff Writers

Lakes throughout Central Florida are filled to capacity, spilling into streets, yards and, in some places, homes. The region simply cannot take any more rain, and the threat of Hurricane Wilma is making residents and government officials anxious.

"I would expect the number of folks having trouble to grow and the severity of their problems to increase with every rain event at this point," said Bill Carlie, a manager with the St. Johns River Water Management District, where new flooding complaints arrive almost daily.

FOR THE RECORD - ********** CORRECTION OR CLARIFICATION PUBLISHED OCTOBER 21, 2005 **********

The continuation of an article on Page A16 Thursday about flooding fears described incorrectly the car of Lake County resident Cindy Dobbs. It is a Dodge Stratus.

****

Dozens of pumps are running to drain lakes throughout Central Florida -- more than 35 in just DeBary. And they'll keep running, with the National Weather Service forecasting increasing rain chances through the weekend.

The additional threat of Hurricane Wilma is prompting local governments to turn things up a notch.

St. Johns officials said Deltona has asked for permission to lower flood-control gates already draining Lake Doyle toward the St. Johns River.

Seminole County asked Wednesday for an emergency order allowing it to pump Sylvan Lake in northwest Seminole, where flooding has killed trees, closed down parts of a nearby park and turned yards into swamps.

Seminole County also announced late Wednesday that it would distribute sandbags today and Friday at Soldiers Creek Park. Other counties are making preparations to do the same.

Flooding

Lake Okeechobee

Groundwater

Concerns about flooding from Hurricane Wilma are especially great in the south half of Florida, where water managers are preparing Lake Okeechobee for a possible direct strike.

Pumping stations and other flood-control structures are working at maximum capacity, lowering Lake Okeechobee to accommodate possible storm runoff.

"They don't want any more rain, but obviously, that's not an option," said Bill Graf, spokesman for the South Florida Water Management District, which monitors the 2,000-mile regional canal system that links south Orange and Osceola counties with the giant lake. "The farther south the storm goes, the better it is for Lake Okeechobee."

The lake can store about 2 more feet of water without significant problems, officials said. But there are concerns that Wilma could veer north and further fill lakes along the Kissimmee Basin that drain into Okeechobee.

District officials were letting water drain earlier this week from the Kissimmee Chain of Lakes into the Kissimmee River, which runs into Lake Okeechobee. But they stopped after lakes fell enough to handle the expected rainfall.

As long as rainfall is no more than 7 to 9 inches, Graf said, flooding throughout the southern portion of Central Florida should be manageable.

Another problem is groundwater, which has become so high in some parts of Central Florida that it's seeping up through cracks in the pavement.

Many lakes are landlocked and can't drain easily elsewhere. Some drain into the ground toward the aquifer, but high groundwater levels are keeping that from happening efficiently. In other lakes, water is removed primarily through evaporation, but that's also not keeping pace with the rainfall.

Already this month, the Orlando area has gotten 31/2 inches of rain, or three-quarters of an inch more than the normal total for all of October. That follows a summer that included one of the wettest Junes on record -- more than 10 inches above normal.

"Everything's just saturated," said Jeff Spence, head of Polk County's environmental-affairs and natural-resources division.

Pumping began last month to lower water levels at Saddlebag Lake. But at Crooked Lake, which has flooded some homes, there's nowhere to pump the water to. The lake it drains into -- Lake Clinch -- is also high.

A similar situation exists in Volusia County, where "any rainfall event could potentially create a setback," county spokeswoman Shelley Szafraniec said. "The severity of flooding in many areas, especially Lake Gertie, can be seen by the presence of dying or dead oak trees."

Flooding isn't new, of course. Some areas began experiencing problems during last year's hurricanes -- and even before then.

Along Big Sand Lake in the Dr. Phillips neighborhood of south Orange County, the yards of million-dollar homes started flooding after a dam broke about two years ago, allowing water in from Little Sand Lake.

Pumps have been running off and on, but docks are still underwater and yards remain soggy.

"Every single storm that comes by we're worried about," said John Jennings, chairman of the Big Sand Lake Advisory Board.

In the Pine Lakes area off State Road 44 in a remote section of Lake County, Cindy Dobbs said flooding problems started in the past three months.

Dobbs parks her Dodge Stratus in the grass near the road and gets into a Chevy pickup so she can get across her flooded driveway at her home on the banks of Dove Lake.

She and her husband, Clint, have never seen anything like it in the 19 years they've owned the property.

"Hopefully, the hurricane won't get us again," Clint Dobbs said.

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