

An Inventory of Spring Vents in Kings Bay
Crystal River, Florida

SUBMITTED TO
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
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For projects: 07PO0001717 and 09POSOW0483
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Vanasse Hangen Brustlin, Inc. (VHB) has completed a field inventory and documentation of spring vents within the Kings Bay portion of Crystal River in Citrus County, Florida. The field inventory was conducted over the period of October 14th – 16th and 27th – 29th 2008, and January 26th – 27th 2009, for a total of eight field days. A summary and cross-reference table of previously identified spring vents was provided to the Southwest Florida Water Management District (District) in a letter report dated October 28, 2008 which evaluated the following documents.

- Hammett, K. M., C.R. Goodwin, and G. L. Sanders 1996. Tidal-Flow, Circulation, and Flushing Characteristics of Kings Bay, Citrus County, Florida, U.S. Geological Survey Open File Report 96-230, Tallahassee, FL.
- Rosenau, J. C., G. L. Faulkner, C. W. Hendry, Jr., and R. W. Hull. 1977. Springs of Florida (revised): Florida Bureau of Geology Bulletin 31, 461 p.
- Scott, T. M., G. H. Means, R. P. Meegan, R. C. Means, S. B. Upchurch, R. E. Copeland, J. Jones, T. Roberts, and A. Willet. 2004. Springs of Florida (Revised): Florida Bureau of Geology Bulletin No. 66, 658 p.

VHB also included information on spring vent locations and names provided by District staff (Dave Dewitt) during the field surveys.

The survey method consisted of navigation by boat to the approximate locations of previously documented spring vents summarized in the above described letter report. Upon arrival at a previously documented spring location efforts were made to detect the spring's presence, including visual observation of spring "boils" from the boat, and surveys along the surface and bay bottom via snorkel and SCUBA equipped divers. In addition to the previously documented springs, other potential spring vents detected by spring signs (i.e., boils) were also investigated.

When a spring vent location was field confirmed, its location was recorded in latitude and longitude coordinates via a GPS equipped arc pad. In addition, the vents depth, dimensions and orientation/configuration were noted. Digital photographs were taken of the vent mouth, when possible, along with occasional surface images.

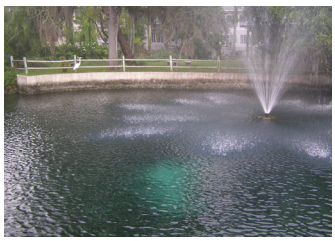
The survey revealed that many of the springs consist of more than one vent in very close proximity. Multiple discharge locations were often observed in a relatively small area that jointly contributed to the overall discharge for that "spring". A single set of GPS coordinates was obtained to mark these vent clusters and each vent cluster was considered a single spring for the purposes of this study. A total of 70 springs were documented and their coordinates are provided in Table 1. This is substantially more than reported in the cross-reference table which noted a potential of 42 springs.

In some areas there are springs that are so close together that they could not be depicted separately on Figure 1 for mapping purposes. A single location was used on Figure 1 to depict the location of these springs, but the individual GPS coordinates of each spring are provided in Table 1. Combining close proximity springs for mapping purposes resulting in the depiction of 52 locations for the 70 springs.

Finally, especially in the case of previously unnamed springs, groups of springs in the same geographic area of Kings Bay were lumped into a single site designation. These "spring complexes" were given the same site name and site number in Table 1 and the same site number on Figure 1. The grouping into spring complexes resulted in a total of 41 named and numbered springs/spring complexes as listed in Table 1 and depicted on Figure 1.

The spring vents varied greatly in flow magnitude from 1st order magnitude vents to 3rd order or less. Many of these vents were previously identified in the earlier reports identified above, however several of the vents were not identified in these reports. When possible these vents were identified or labeled consistent with their historic designations. In some instances, names have been provided (in italics) for previously unnamed springs of suitable size.

Provided below are physical descriptions of the vents/vent complexes surveyed during the field events. Information relative to approximate flow and depth are based upon the conditions at the time of the survey. Most of the surveys took place from mid to low tides so the approximate flows were likely on the high side and the depths on the low side. The descriptions are presented in a general north to south order based upon the vents geographic locations. The number in parentheses at the end of the spring name corresponds to the spring numbers on Figure 1 and Table 1.



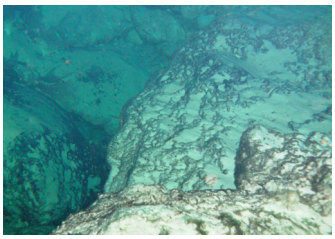
- Hammett 23/Miller's Creek Spring (1). This spring is located at the head of Miller's Creek at coordinates 28°54'05.10"N, 82°36'12.49"W and consists of a two vents within a large fracture in the bottom. Dimensions of these vents were approximately 1.2 feet X 1.0 feet, and 2.4 feet X 0.75 feet, respectively. Water depths at the edge of the fracture were approximately 10.0 feet, while the deeper center of the vents was approximately 28 feet. Discharge volumes were low.
- Fountain Spring/City Hall Spring/Little Spring/Independence Spring (2). This spring is located adjacent to the City of Crystal River City Hall at 28°54'01.29"N, 82°35'43.60"W. The center of this spring is within a walled and lined pond that is roughly circular in shape, with an approximate diameter of 85 feet and an estimated depth of five to six feet deep. As access into the pond is restricted, a physical description of the spring vent mouth was not made. Spring flow was moderate. This walled pond discharges

on its western side to an approximately 15 foot wide vertical sided ditch, which flows south under U.S. HWY 19 and into Kings Bay.

- *Charlie's Fish House Spring* (3). This spring is located immediately adjacent to the parking lot seawall of Charlie's Fish House restaurant at 28°53'57.32"N, 82°35'44.23"W, which is at the very northeastern corner of Kings Bay. This very small spring vent is estimated at approximately 0.5 feet in diameter and had a low flow. Water depths ranged from exposed at low tide, to approximately two feet deep at high tide. This spring was not identified on any of the previous studies.

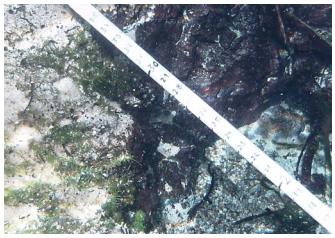
- Hammett 25/*Birds Underwater Spring* (4). This spring is located adjacent to Birds Underwater Tours dive shop at 28°53'56.05"N, 82°35'47.56"W under a covered dock slip, and consists of two very small spring vents estimated at approximately 0.5 to 0.75 feet in diameter. Water depths are estimated to range from approximately 1.0 feet at low tide to 3 feet at high tide. Discharge volumes associated with this spring were minimal.

- Hammett 27/Pool Spring (5). This spring is enclosed within a walled off swimming area associated with the Kings Bay Lodge resort, creating a spring fed swimming pool. This spring is located at 28°53'54.48"N, 82°35'43.02"W and consists of multiple small spring vents. One vent is located within the "pool" itself, and has approximate dimensions of 3.0 feet X 0.5 feet. Three other vents are located outside of the main pool area, but discharge into the pool through a small flow-way under the pool stairs. Measurements could not be made on these vents due to lack of access. Collectively pool spring discharges into Kings Bay through a small square orifice. Water depths within the pool were estimated at 3 feet deep, and the discharge was minimal.

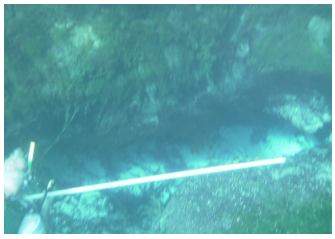


- Hammett 1/Catfish Spring (6). This spring is located near the Best Western Crystal River Resort and adjacent to a residential single family dock at 28°53'53.50"N, 82°35'55.54"W. It consists of one main spring vent opening with approximate dimensions of four feet by eight feet, and numerous other associated smaller cracks and vents ranging from 0.5 feet X 0.5 feet to 1.0 feet X 1.0 feet. This spring has numerous pieces of lumber and tree limbs within its opening, and the water depth was approximately 15 feet. Discharge was estimated to be moderate to high.

- Hammett 26/*NW 9th Avenue Springs* (7). This spring complex is located at the head of the western most embayment of the northern portion of Kings Bay at 28°53'52.93"N, 82°36'04.96"W. It is approximately 8 feet off of the sea-walled edge, and consists of three small vents with approximate dimensions of 1.0 feet X 0.8 feet, 0.3 feet X 0.4 feet, and 0.9 feet X 0.8 feet. Water depths were approximately 3.5 feet to 4.0 feet deep, with depths inside the spring vents ranging from 4.0 feet to 4.8 feet. Discharge volumes were estimated to be low to minimal. It appears unlikely that these small springs represent those measured by Hammett due to their small size and location to the east of the canal indicated in the Hammett report. The location of Hammett 26 near the mouth of the canal would seem to indicate that this was a cross-section location for flow measurement.



- Hammett 4/House Spring (8). This spring is located at the head of the eastern most embayment of the northern portion of Kings Bay at 28°53'45.44"N, 82°35'22.84"W within a sea–walled enclosure. This enclosure is obviously intended to be used as a swimming area, complete with a pool slide and ladder, for a single family residence. This multiple vent spring area is approximately four feet deep at the center of the "pool"/swimming enclosure. Approximate dimensions of the larger vents within this spring complex include a 2.4 X 2.3 foot vent, a 0.2 X 0.5 foot vent, and a 1.0 X 0.5 foot vent. Numerous other "sand boils" were also observed within this area. Discharge volumes were estimated to be low to moderate.



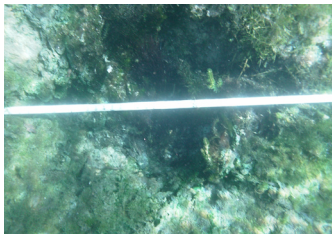
- Hammett 5/Jurassic Spring (9). This spring is located approximately 360 feet south of House Spring, within the eastern embayment off of the northern portion of Kings Bay at 28°53'42.08"N, 82°35'23.93"W. Like House Spring, Jurassic Spring has been partially sea-walled with a few boat docks installed as well. This spring consists of two larger vent mouths, one measuring approximately 16 feet long and with varying widths of between 3.5 and 4.2 feet, and the second vent mouth measuring approximately 4.9 feet long X 0.9 feet wide. Within the larger vent mouth the flow was determined to exit from three primary points, the first measured at 0.9 X 1.8 feet, the second measured at 0.3 X 0.3 feet, and the third measured at 2.1 X 4.0 feet. Approximate depths to bottom within the spring area ranged between 13 and 15 feet. Discharge volumes within this spring complex were estimated to be moderate to high.

- Hammett 3/Hunters Spring/American Legion Spring (10). This spring is located approximately 800 feet west of Jurassic Spring within the eastern embayment off of the northern portion of Kings Bay at 28°53'40.41"N, 82°35'32.91"W. It is immediately offshore of Hunters Spring Park and consists of five individual spring vents clustered within an approximate 10 foot diameter circle and at approximate 15 foot depth. Approximate dimensions of the vent mouths include two approximately round vents of 2.0 and 1.5 feet diameters, respectively, an oblong vent of 4.0 feet X 1.1 feet, an oblong vent with a length of 5.0 feet and widths of 1.5 to 2.5 feet, and a kidney bean shaped vent approximately 4.0 feet long by 1.5 feet wide at one end of the "bean" and 2.0 feet wide at the other end of the "bean" (and connected by a narrower area). Discharge volumes within this spring complex were estimated to be moderate to high.

- Hammett 21/Magnolia Circle Spring (11). This spring is located near the eastern tip of the Magnolia Shores subdivision/residential area at 28°53'38.49"N, 82°35'58.84"W. It consists of a single vent that is shaped somewhat like a kidney, and has approximate dimensions of 3.1 feet X 2.0 feet and an approximate depth of 5 feet. Most of the flow was determined to be coming from the left hand lobe of the vent, which has dimensions of 2.0 feet X 0.5 feet. The right hand lobe has approximate dimensions of 1.6 feet X 0.5 feet. Discharge volumes from this spring were estimated to be high.

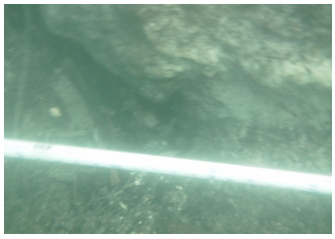
- *Pete's Pier Spring* (12). This spring complex is located in the northern half of Kings Bay at 28°53'37.85"N, 82°35'55.60"W. It is approximately 400 to 450 feet west of the Pete's Pier boat ramp, at an approximate 6 foot depth, and consists of two vents aligned in an approximately north/south direction. The northern of the two vents is approximately 0.75 feet X 1.1 feet, while the southern of the two vents is approximately 0.1 feet X 1.6 feet. This vent system is believed to be part of a larger fracture line in the

bay bottom in this area, and more vents, though unobserved during the field event, are thought to be probable. Discharge volumes from this spring complex were estimated to be moderate.



- Hammett 6/*Moray Springs* (13). This spring complex is located at the head of the moderately sized cove behind Pete's Pier Marina in the northern portion of Kings Bay. It is surrounded by homes, sea-walls and larger boat docks associated with the Agua Vista subdivision. Multiple spring vent clusters with coordinates of 28°53'37.03"N, 82°35'41.57"W; 28°53'37.01"N, 82°35'41.4"W; and 28°53'36.99"N, 82°35'41.09"W are present within this complex. Some of the larger vent dimensions within each of these clusters measured approximately 2.0 X 1.5 feet, 2.0 X 0.8 feet, 0.8 X 0.9 feet, 0.8 X 0.8 feet, and 0.5 X 0.9 feet. Numerous other smaller and ill-defined vents were also observed. Discharge volumes were estimated to be low to moderate.

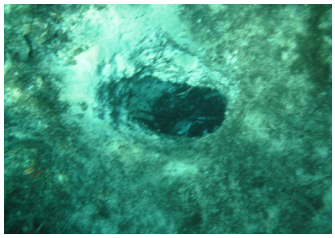
- Hammett 20/Shark Sink (14). This feature is located on the extreme western edge of Kings Bay, just south of the discharge point into the Crystal River at 28°53'31.69"N, 82°36'20.86"W. This feature is approximately 30 to 40 feet deep and consists of a limestone bottom covered in a thick layer of silt and fine sediment. No spring flow was observed at this feature, however this result must be viewed with caution at this time as visibility was so poor that minor spring flow could be undetected.



- Hammett 7/*Paradise Isles* (15). This spring is located approximately opposite 1218 SE Kings Bay Drive within a sea walled cove associated with a canal lot in the Paradise Isles subdivision at 28°53'27.18"N, 82°35'42.02"W. This spring complex consists of approximately 12 vents mouths/fractures, most of which are very small. Dimensions of the larger vents include an approximately 0.5 foot diameter circular vent, an oblong 1.0 X 0.5 foot vent, and a large fracture vent approximately 5.0 feet X 0.5 feet in size. Water depths within this area are approximately 10 to 12 feet deep. Discharge volumes were estimated to be low.

- Hammett 8/Manatee Sanctuary/Gator Hole/Magnolia Spring/Crystal Spring (16). This spring, also associated with the Paradise Isles subdivision canal system, is approximately 720 east of the Hammett 7 spring complex at 28°53'26.50"N, 82°35'33.27"W. This complex of approximately 13 vents is aligned along an approximately 60 foot long fracture that is sinusoidal in shape within the greater "bowl" shape of the spring formation. Depths of this fracture range from approximately 15 feet deep at the shallow end of the fracture, to approximately 25 feet deep at the deepest areas of the fracture. Individual vent sizes along the fracture ranged between approximately 1.2 feet X 1.0 feet, up to approximately 5.0 feet X 2.0 feet. Discharge volumes were estimated to be high.

- *Buzzard Island Spring* (17). This spring is located east of the northern tip of Buzzard Island at 28°53'24.97"N, 82°35'53.64"W. This spring appears to have been evaluated by Rosenau. It consists of a single vent that is oval in shape with dimensions of 1.7 feet X 0.8 feet, and an approximate depth from the surface of 8 feet. Discharge volumes were estimated to be moderate.

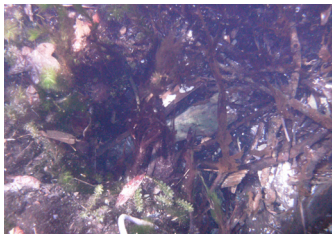


- Hammett 10/Three Sisters # 1/Three Sisters Springs/Middle Springs # 1 (18). This spring is part of a larger complex that consists of three spring "bowls" aligned upon an approximate northwest -southeast axis and with an approximate total length of 250 feet. Each bowl of this spring complex contained spring vents, and for purposes of this survey only the center coordinates of each bowl were recorded. The north-western bowl of this trio is centered at 28°53'19.46"N, 82°35'21.37"W, and contains approximately twelve circular vents with dimensions ranging between 1.0 feet and 0.5 feet. Water depths were estimated at 8 to 10 feet deep and discharge volumes were low to moderate.

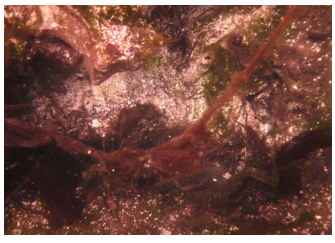
- Hammett 28/Three Sisters # 2/Three Sisters Springs/Middle Springs # 2 (19). The middle bowl of the trio is centered at 28°53'18.70"N, 82°35'20.87"W and contains what is effectively (due to debris, including tree limbs and vegetation within the spring) a very large kidney shaped vent approximately 20 feet long by 5 feet wide. Water depths within this bowl were approximately 20 feet deep and discharge volumes were high.

- Hammett 28/Three Sisters # 3/Three Sisters Springs/Middle Springs # 3 (20). The southeastern bowl of the trio is centered at 28°53'18.14"N, 82°35'20.16"W, and contains approximately six vents with dimensions ranging between 2.1 feet X 2.1 feet to 0.4 feet X 0.4 feet. Water depths were estimated at approximately 15 to 20 feet deep and discharge volumes were high.

- Hammett 9/Kings Bay #1/Idiots Delight #1 (21). This spring complex is located within the Paradise Isles and Palm Island subdivision canal system approximately 1400 feet southeast of the Hammett 8 spring complex. These vents are located at 28°53'17.22"N, 82°35'23.03"W and consist of two vents, one with approximate dimensions of 3.0 feet X 2.8 feet, the other with dimensions of 0.5 X 0.3 feet, both of which are located immediately adjacent to the shoreline and west of Three Sisters Springs run. Water depths in this area were approximately 4 feet deep and discharge volumes were moderate.



- Hammett 11/ Idiots Delight #2 (22). The vents in this complex are southeast of Hammett 9 and are located at 28°53'16.55"N, 82°35'22.04"W. The vent complex consists of six vents with dimensions ranging from 3.5 feet X 1.5 feet, to 0.4 feet X 0.3 feet. These vents are approximately 6.0 feet deep and discharge volumes were moderate.

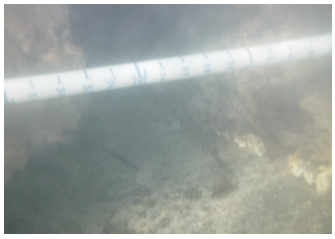


- Hammett 11A/ Idiots Delight #3/Three Sisters Run (23). Another spring, herein identified as Hammett 11A, is located south of Hammett 9 and Hammett 11 within the center of the dredged canal at 28°53'16.24"N, 82°35'22.55"W. This spring consists of a single vent with approximate dimensions of 2.0 feet X 1.9 feet. The water depth was approximately 9.5 feet deep and discharge volume was moderate.

- *Parker Island North Spring Complex* (24). This spring complex consists of approximately 5 to 8 vents in water depths ranging between 5 and 12 feet of water scattered over a moderately sized area. This spring complex appears to have been evaluated by Rosenau. Coordinates of these vents include the following locations: 28°53'13.30"N, 82°35'38.33"W; 28°53'13.23"N, 82°35'38.51"W; 28°53'13.21"N, 82°35'38.76"W;

28°53'13.10"N, 82°35'38.3"W; and 28°53'12.33"N, 82°35'41.58"W. All vents were irregular in shape, this due to fractured limestone along the bottom in this area, and vent sizes ranged from 1.0 feet X 0.25 feet to 3.0 feet X 4.0 feet. Discharge volumes were low to moderate.

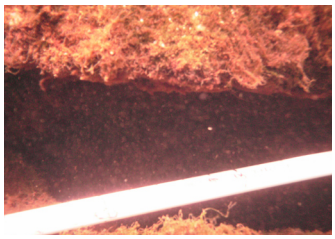
- Hammett 12/Parker Island Springs/Little Hidden Spring (25). This three vent spring complex is located within the interior of Parker Island, and the spring bowl edges are exposed at low tide. Coordinates of these three vents include the following locations: 28°53'08.84"N, 82°35'38.69"W; 28°53'08.74"N, 82°35'38.47"W; and 28°53'08.48"N, 82°35'38.26"W. Vent sizes ranged between approximately 4.0 feet X 1.5 feet to approximately 0.4 feet in diameter. Discharge volumes were low to moderate.
- *Banana Island North Spring Complex* (26). This complex of somewhat widely separated springs is located on the north side of Banana Island and consists of at least four separate spring vent areas, some with multiple vents. Some of these springs appear to have been evaluated by Rosenau and one may correspond with Hammett 14. Coordinates of these vents include the following locations: 28°53'05.92"N, 82°35'46.10"W; 28°53'05.46"N, 82°35'46.09"W; 28°53'04.48"N, 82°35'47.12"W; and 28°53'04.40"N, 82°35'45.35"W. The vent dimensions ranged from a 15 foot X 4 foot crack/fracture line in the bottom, to a 2.5 foot X 0.25 foot crack/fracture line. Water depths ranged from approximately 2.0 feet at the shallowest vent, to approximately 12 feet deep at the deepest vent. Discharge volumes were estimated to range from low to moderate, depending on the vent.



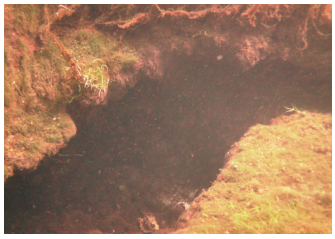
- Hammett 13/*FWS Spring Complex* (27). This spring system consists of two main spring vents located at coordinates 28°53'03.29"N, 82°35'36.87"W and 28°53'01.98"N, 82°35'37.11"W. These vents consisted of fractures in the limestone along the bottom, and ranged in size from 6.0 X 0.5 feet to 2.3 feet X 1.5 feet. Water depths were approximately 10 feet and discharge volumes were estimated to be moderate to high.
- *Banana Island East Springs* (28). This multiple vent spring complex consisted of six main vent areas observed on the east end of Banana Island. Coordinates for these areas include: 28°52'58.18"N, 82°35'40.51"W; 28°52'58.09"N, 82°35'39.95"W; 28°52'57.85"N, 82°35'40.45"W, 28°52'57.65"N, 82°35'40.27"W; 28°52'57.38"N, 82°35'39.76"W; and 28°52'57.03"N, 82°35'40.16"W. These spring vents were all located on or near the waters edge at the time of the field event, and consisted of very small vents in the mud bottom. Water depths ranged from exposed, to approximately 1 foot, and discharge volumes were estimated to be low.

- *Banana Island West Springs* (29). This multiple vent spring complex consisted of three main boils observed on the west end of Banana Island primarily located at coordinates 28°52'55.63"N, 82°35'48.63"W and 28°52'55.53"N, 82°35'48.62"W. One of these springs may have been evaluated by Rosenau. One boil consisted of an approximately 12 foot long fracture with approximately 3 vents along its length. These vents ranged in length between 1.0 feet and 0.5 feet, and were all approximately 0.25 feet wide. This fracture line was approximately 4 feet deep and discharge volumes were low. The second, and volume wise greater spring, was found to be encircled by cement blocks and exiting into Kings Bay via a 0.75 foot X 0.5 foot hole. This spring vent was approximately 2.0 feet deep and discharge volumes were moderate. A third boil was

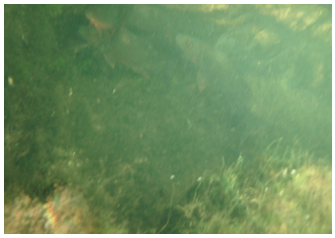
observed at the water's edge and consisted of numerous small vents with approximately 0.15 to 0.25 foot diameters. The discharge volume from these vents was low.



- Hammett 15/Mullets Gullet Spring/Tarpon Hole #2 (30). This spring system is the eastern most vent of a large three vent systems in this area, and is located at coordinates 28°52'54.82"N, 82°35'39.29"W. It consists of multiple large undercut type fractures in the bottom through which the spring is discharging. These cracks were measured at 15 feet X 4 feet wide, 14 feet long X 2 feet wide, and 9 feet X 2 feet wide, and were roughly orientated in a circular formation. Water depths at the edge of the circular fracture formation were approximately 4 to 5 feet deep, and approximately 15 feet deep in the center. Discharge volume was high.

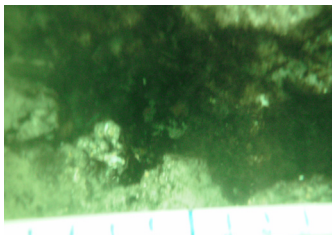


- Hammett 2/Tarpon Hole/Big Hole/Crystal Spring (31). This spring vent system is the middle vent of the three large vent systems in this area, and is located at coordinates 28°52'54.68"N, 82°35'39.37"W. It consists of multiple fractures and holes in the bottom through which flow was detected. The fractures can generally be described to be trending in a roughly circular formation, and appear to represent a large undercut shelf/cavern which collapsed sometime in the past. Approximate dimensions of the cracks/fractures in the limestone ranged from 7.0 feet by varying widths up to 2.5 feet, 10 feet x 0.9 feet, 7 feet X 0.4 to 2.0 feet, and 5.0 feet X 2.0 feet. In addition, the small holes in the bottom can be described as irregular in shape, and all with similar dimensions of approximately 1.5 X 1.0 feet. Water depths at the edge of the spring formation were approximately 4 to 5 feet, while depths at the deepest center were approximately 10 to 15 feet. Discharge volumes at this spring system were high.

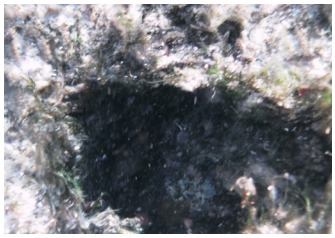


- Hammett 16/King Spring/Grand Canyon Spring (32). This spring vent system is located south of Banana Island at coordinates 28°52'54.37"N, 82°35'41.64"W, and is the western most spring boil of the three large vent systems in this area. Three spring vents are found in this spring with dimensions ranging from 20 feet long X 8 feet wide, to two vents with similar dimensions of approximately 3.0 feet X 1.5 feet. Water depths at the vent mouths were approximately 28 feet, and discharge volumes were moderate.

- *Plantation Point Hole* (33). This historic spring vent is located just off of a seawall to the northeast of the Plantation Inn property at coordinates 28°52'51.89"N, 82°35'29.22"W. A knowledgeable individual informed District staff that it used to flow (David DeWitt, personal communication). The edges of the former vent are approximately 5 feet deep (from the surface) and slope to approximately 10 feet at the bottom. No flow was observed at this former spring.



- *Dave's Quest Springs* (34). This three vent spring complex is located approximately 200 feet south-southwest of King Spring at coordinates 28°52'49.54"N, 82°35'42.92"W, 28°52'49.24"N, 82°35'43.29"W, and 28°52'48.41"N, 82°35'42.71"W. At least one of these springs appears to have been evaluated by Rosenau. The spring vents consist of both fractures and solution holes in the shallow limestone shelf in this area. Dimensions of these fractures ranged from 6 feet long X 0.5 feet wide, to 4 feet long X 2 feet wide. Depths at the edges of the fractures ranged from 6 feet to 8 feet, and discharge volumes were moderate.

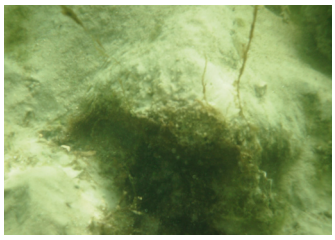


- Hammett 17/*Golfview* (35). This multiple vent spring complex is located north of the Golfview subdivision. It consists of two closely spaced vents at coordinates 28°52'46.32"N, 82°35'32.19"W, and 28°52'46.26"N, 82°35'31.9"W, with dimensions of 3.0 feet x 1.5 feet and 1.5 feet x 1.5 feet, respectively, located within the middle of the channel area at an approximate 5 foot depth. Discharge volumes at these vents were low. In addition, a third multiple spring vent complex, located approximately 150 to 200 feet away to the southeast, was noted near the edge of the channel at 28°52'45.02"N, 82°35'30.7"W. This third vent complex consisted of approximately 10 spring vents within the deep algae covered bottom, with dimensions ranging from 2.0 feet x 1.8 feet to 0.3 feet x 0.3 feet. Discharge volumes at this third vent complex were low to moderate. A follow up visit was made to the third vent complex approximately 3 months later, and it was noted that the dimensions and number of spring vents had changed, and there was now only one large vent with approximate dimensions of 5 feet X 4 feet and strong flow.

- *Lightbourn's Ledge* (36). This limestone feature is located at 28°52'45.26"N, 82°35'57.09"W and consists of an undercut ledge approximately 8 to 10 feet deep. No spring flow was observed at this feature, though it appears that flow was likely at some point in the past based upon the ledges morphologic features. This spring appears to have been evaluated by Rosenau.

- *Wynn Court Springs* (37). These vents consist of several small to moderately large fractures in the limestone shelf. At least one of these springs appears to have been evaluated by Rosenau. Coordinates for these various vent locations include: 28°52'42.41"N, 82°35'50.60"W; 28°52'42.31"N, 82°35'47.33"W; 28°52'42.18"N, 82°35'49.62"W; 28°52'42.00"N, 82°35'50.68"W; and 28°52'41.34"N, 82°35'48.20"W. Dimensions of these fractures ranged between 6 feet long X 0.2 feet wide, to 3 feet long x 0.25 feet wide. Water depths at the edges of these fractures were all about 1 foot deep, and discharge volumes were low.

- Hammett 18/Black Spring (38). This spring complex consists of multiple fractures within the limestone bottom. It is located at coordinates 28°52'39.08"N, 82°35'57.28"W. Dimensions of these fractures ranged between 15 feet long X 0.5 feet wide and 6 feet long X 0.5 feet wide. Water depths were 3 to 5 feet deep and discharge volumes were moderate.



- Hammett 19/*Sid's Springs* (39). This multiple vent spring complex consists of two larger adjacent bowl areas, each populated by several spring vents. It is located at coordinates 28°52'36.66"N, 82°35'50.99"W. Approximately 14 individual vents are located within this complex, with dimensions ranging between 6.0 feet X 3.0 feet to 1.5 feet X 1.5 feet. Water depths at the edge of the spring bowls were approximately 1.0 feet, and water depths of approximately 12 to 15 feet deep were observed within the deeper centers. Discharge volumes were moderate to high.

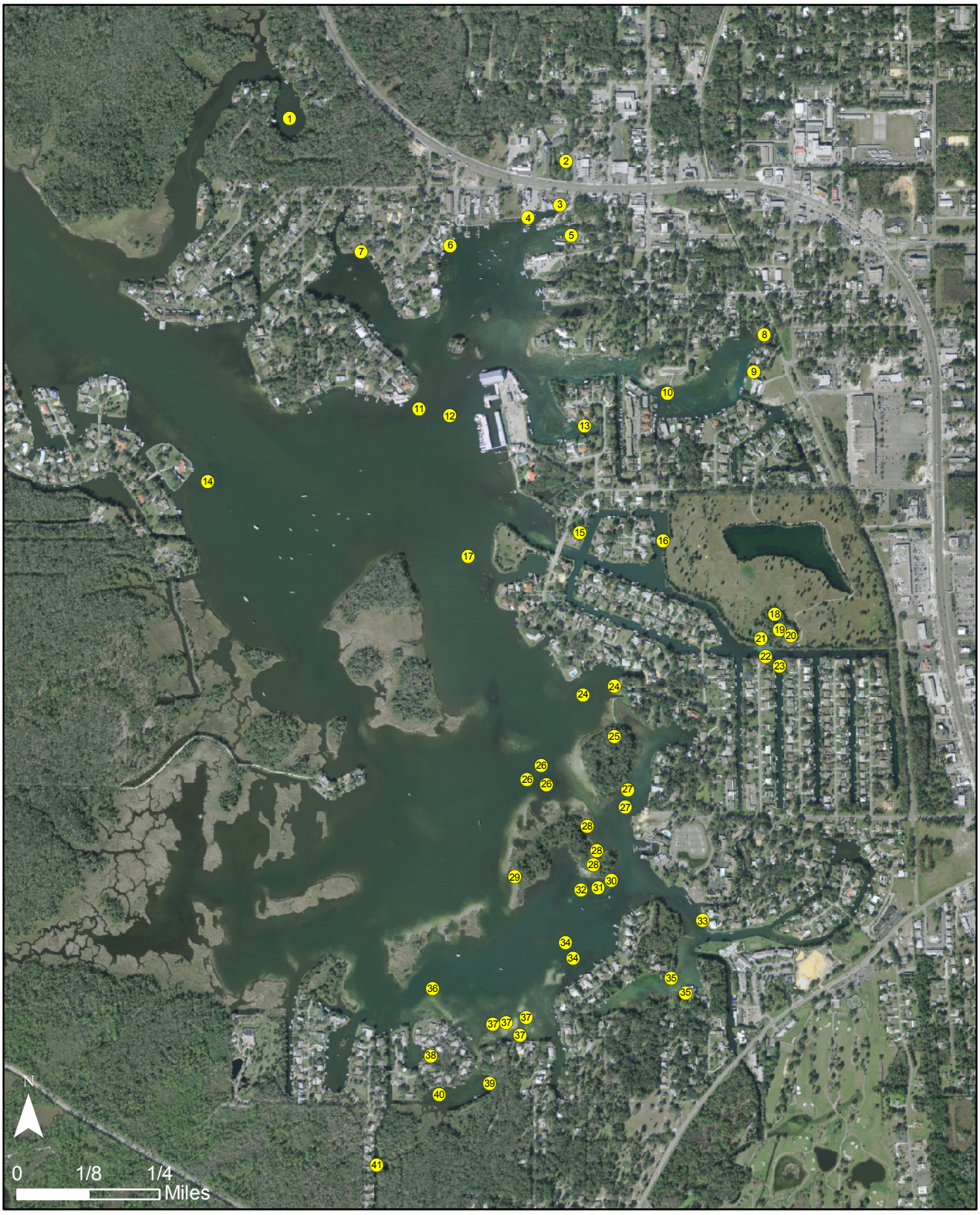
- *Gary's Grotto* (40). This spring complex consists of fractures within the shallow limestone bottom. It is located approximately 400 feet west southwest of Hammett 19 at coordinates 28°52'35.51"N, 82°35'56.35"W and 28°52'35.38"N, 82°35'56.18"W. Dimensions of these fractures ranged between 15 to 6 feet long X 2 to 1 foot wide. Water depths ranged from 0.5 feet to 10 feet below the surface and discharge volumes were moderate.

- *Swamp Sink* (41). The southernmost site visited is a circular feature located off a canal. This area is surrounded by swamp and appears to have been at least partially bermed. The area is uniformly five feet deep. No vents were located, but stratified water appears to indicate diffuse flow. An adjacent resident indicated that the area no longer flows.

There is a karst feature at the east end of Hook Island within the southwest portion of Kings Bay. This feature is an apparent historical location of a spring. Discharge was not observed at this location during several investigations by District staff during 2007 and 2008 (David DeWitt, personal communication). This feature is located at 28°52'52.77"N, 82°36'15.00"W, but has not been depicted on Figure 1.

Three springs designated by Hammett as 22, 24 and 26 could not be located. They are theorized to have been discharge measurement cross-section locations. Apparent spring discharge was observed at 24 (and subsequently further down the canal at 26), but the source of the discharge was quite a distance upstream.

Electronic files of this report, GIS files of Figure 1, copies of the field notes, and digital surface and underwater photography of the springs were provided to the District.



Date: 2/10/09

Revised:

Figure 1
Kings Bay Spring Vent Survey
Location Map
Citrus County, Florida

Vanasse Hangen Brustlin, Inc.

VHB

8043 Cooper Creek Blvd.
Suite 201
University Park, Florida 34201

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Table 1. Documented Kings Bay Spring Vents

ID NUMBER	NAME	LATITUDE	LONGITUDE
1	Hammett 23/Miller's Creek Spring	28° 54'05.10"N	82° 36'12.49"W
2	Fountain Spring/City Hall Spring	28° 54'01.29"N	82° 35'43.60"W
3	*Charlie's Fish House Spring*	28° 53'57.32"N	82° 35'44.23"W
4	Hammett 25/*Birds Underwater Spring*	28° 53'56.05" N	82° 35'47.56"W
5	Hammett 27/Pool Spring	28° 53'54.48" N	82° 35'43.02"W
6	Hammett 1/Catfish Spring	28° 53'53.50"N	82° 35'55.54"W
7	Hammett 26/*NW 9th Avenue Springs*	28° 53'52.93"N	82° 36'04.75"W
7	Hammett 26/*NW 9th Avenue Springs*	28° 53'52.93"N	82° 36'04.96"W
7	Hammett 26/*NW 9th Avenue Springs*	28° 53'52.91"N	82° 36'04.97"W
8	Hammett 4/House Spring	28° 53'45.44"N	82° 35'22.84"W
9	Hammett 5/Jurassic Spring	28° 53'42.08"N	82° 35'23.93"W
10	Hammett 3/Hunters Spring/American Legion Spring	28° 53'40.41"N	82° 35'32.91"W
11	Hammett 21/Magnolia Circle Spring	28° 53'38.49"N	82° 35'58.84"W
12	*Pete's Pier Spring*	28° 53'37.85"N	82° 35'55.60"W
13	Hammett 6/*Moray Springs*	28° 53'37.03"N	82° 35'41.57"W
13	Hammett 6/*Moray Springs*	28° 53'37.01"N	82° 35'41.40"W
13	Hammett 6/*Moray Springs*	28° 53'36.99"N	82° 35'41.09"W
14	Hammett 20/Shark Sink	28° 53'31.69"N	82° 36'20.86"W
15	Hammett 7/*Paradise Isles*	28° 53'27.18"N	82° 35'42.02"W
16	Hammett 8/Manatee Sanctuary/Gator Hole/Magnolia Spring/ Crystal Spring	28° 53'26.50"N	82° 35'33.27"W
17	*Buzzard Island Spring*	28° 53'24.97"N	82° 35'53.64"W
18	Hammett 10/Three Sisters #1/Three Sisters Springs/Middle Springs # 1	28° 53'19.46"N	82° 35'21.37"W
19	Hammett 28/Three Sisters #2/Three Sisters Springs/Middle Springs # 2	28° 53'18.70"N	82° 35'20.87"W
20	Hammett 28/Three Sisters #3/Three Sisters Springs/Middle Springs # 3	28° 53'18.14"N	82° 35'20.16"W
21	Hammett 9/ Kings Bay #1/ Idiots Delight #1	28° 53'17.22"N	82° 35'23.03"W

ID NUMBER	NAME	LATITUDE	LONGITUDE
22	Hammett 11 /Idiots Delight #2	28° 53'16.55"N	82° 35'22.04"W
23	Hammett 11A/Idiots Delight #3/ Three Sisters Run	28° 53'16.24"N	82° 35'22.55"W
24	*Parker Island North Spring Complex*	28° 53'13.30"N	82° 35'38.33"W
24	*Parker Island North Spring Complex*	28° 53'13.23"N	82° 35'38.51"W
24	*Parker Island North Spring Complex*	28° 53'13.21"N	82° 35'38.76"W
24	*Parker Island North Spring Complex*	28° 53'13.10"N	82° 35'38.30"W
24	*Parker Island North Spring Complex*	28° 53'12.33"N	82° 35'41.58"W
25	Hammett 12/Parker Island Springs/Little Hidden Spring	28° 53'08.84"N	82° 35'38.69"W
25	Hammett 12/Parker Island Springs/Little Hidden Spring	28° 53'08.74"N	82° 35'38.47"W
25	Hammett 12/Parker Island Springs/Little Hidden Spring	28° 53'08.48"N	82° 35'38.26"W
26	*Banana Island North Spring Complex*	28° 53'05.92"N	82° 35'46.10"W
26	*Banana Island North Spring Complex*	28° 53'05.46"N	82° 35'46.09"W
26	*Banana Island North Spring Complex*	28° 53'04.48"N	82° 35'47.12"W
26	*Banana Island North Spring Complex*	28° 53'04.40"N	82° 35'45.35"W
27	Hammett 13/*FWS Spring Complex*	28° 53'03.29"N	82° 35'36.87"W
27	Hammett 13/*FWS Spring Complex*	28° 53'01.98"N	82° 35'37.11"W
28	*Banana Island East Springs*	28° 52'58.18"N	82° 35'40.51"W
28	*Banana Island East Springs*	28° 52'58.09"N	82° 35'39.95"W
28	*Banana Island East Springs*	28° 52'57.85"N	82° 35'40.45"W
28	*Banana Island East Springs*	28° 52'57.65"N	82° 35'40.27"W
28	*Banana Island East Springs*	28° 52'57.38"N	82° 35'39.76"W
28	*Banana Island East Springs*	28° 52'57.03"N	82° 35'40.16"W
29	*Banana Island West Springs*	28° 52'55.63"N	82° 35'48.63"W
29	*Banana Island West Springs*	28° 52'55.53"N	82° 35'48.62"W
30	Hammett 15/Mullets Gullet Spring/Tarpon Hole #2	28° 52'54.82"N	82° 35'39.29"W

ID NUMBER	NAME	LATITUDE	LONGITUDE
31	Hammett 2/Tarpon Hole/Big Hole/Crystal Spring	28° 52'54.68"N	82° 35'39.37"W
32	Hammett 16/King Spring/Grand Canyon Spring	28° 52'54.37"N	82° 35'41.64"W
33	*Plantation Point Hole*	28° 52'51.89"N	82° 35'29.22"W
34	*Dave's Quest Springs*	28° 52'49.54"N	82° 35'42.92"W
34	*Dave's Quest Springs*	28° 52'49.24"N	82° 35'43.29"W
34	*Dave's Quest Springs*	28° 52'48.41"N	82° 35'42.71"W
35	Hammett 17/*Golfview*	28° 52'46.32"N	82° 35'32.19"W
35	Hammett 17/*Golfview*	28° 52'46.26"N	82° 35'31.90"W
35	Hammett 17/*Golfview*	28° 52'45.02"N	82° 35'30.70"W
36	*Lightbourn's Ledge*	28° 52'45.26"N	82° 35'57.09"W
37	*Wynn Court Springs*	28° 52'42.41"N	82° 35'50.60"W
37	*Wynn Court Springs*	28° 52'42.31"N	82° 35'47.33"W
37	*Wynn Court Springs*	28° 52'42.18"N	82° 35'49.62"W
37	*Wynn Court Springs*	28° 52'42.00"N	82° 35'50.68"W
37	*Wynn Court Springs*	28° 52'41.34"N	82° 35'48.20"W
38	Hammett 18/Black Spring	28° 52'39.08" N	82° 35'57.28"W
39	Hammett 19/*Sid's Springs*	28° 52'36.66"N	82° 35'50.99"W
40	*Gary's Grotto*	28° 52'35.51"N	82° 35'56.35"W
40	*Gary's Grotto*	28° 52'35.38"N	82° 35'56.18"W
41	*Swamp Sink*	28° 52'29.10"N	82° 36'02.06"W

Vanasse Hangen Brustlin, Inc.