Woodville Karst Plain Hydrologic Research Program

Report on Tasks Performed in 2011 & 2012 Under FDEP Contract RM100 Amendment #3

September 12, 2012

Prepared for:

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I, Kevin E. Day, P.G., no. 2517, have read and agree with the findings in this report titled *Woodville Karst Plain Hydrologic Research Program: Report on Tasks Performed in 2011 & 2012 Under FDEP Contract RM100 Amendment #3 dated September 12, 2012* and do hereby certify that I currently hold an active professional geology license in the state of Florida. The report on the status of tasks, including the maintenance of the WKP instrumentation network, the groundwater tracer test and the groundwater model revision prepared by Dr. Todd R. Kincaid & Brent A. Meyer of GeoHydros, LLC, has been reviewed by me and found to be in conformance with currently accepted geologic practices, pursuant to Chapter 492 of the Florida Statutes.

Kevin Day, P.G.
Florida License No. 2517

September 12, 2012
Date

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Table 8. Summary of water depths and temperatures measured by the CTD probes deployed in piezometers at Shell Point and Live Oak Island for the surge study.

		BG02	GS01	GS02	ST04	ST05		GS02	ST05
Water Depth (ft)	Count	40,216	41,093	40,869	41,645	43,795	Temperature (C)	40,869	43,795
	Max	7.12	8.28	7.09	7.97	41.98		27.26	23.70
	Min	1.50	1.21	2.01	4.21	38.51		18.05	16.90
	Range	5.62	7.07	5.08	3.76	3.48		9.21	6.80
	Average	4.22	4.47	4.83	5.65	40.17		24.01	21.18
	STDEV	1.25	1.09	0.59	0.49	0.54		2.64	1.85
	90%tile	5.88	5.89	5.51	6.30	40.89		27.02	23.26
	75%tile	5.32	5.28	5.14	5.95	40.51		26.48	22.90
	50%tile	4.21	4.47	4.80	5.64	40.15		24.77	21.62
	25%tile	3.17	3.67	4.47	5.34	39.81		21.28	19.30
	10%tile	2.62	3.04	4.15	5.07	39.50		20.43	18.66

Table 9. Summary of conductivity-related parameters measured by the CTD probes deployed in piezometers at Shell Point and Live Oak Island for the surge study.

		GS02	ST05		GS02	ST05		GS02	ST05
Actual Conductivity (µS)	Count	36,652	39,569	Specific Conductivity (mS)	36,652	39,569	Salinity (PSU)	36,652	39,569
	Max	1430.91	16083.08		1530.29	16380.56		0.78	9.96
	Min	479.00	11239.92		481.35	12232.46		0.28	7.42
	Range	951.91	4843.16		1048.94	4148.10		0.50	2.54
	Average	846.83	14094.65		867.11	15047.54		0.44	9.04
	STDEV	210.95	854.88		228.82	802.29		0.11	0.45
	90%tile	1099.88	15127.12		1142.43	15918.06		0.57	9.48
	75%tile	1039.49	14789.75		1093.32	15679.00		0.55	9.36
	50%tile	817.17	13991.95		846.40	15339.32		0.44	9.19
	25%tile	656.69	13615.26		643.98	14414.51		0.34	8.84
	10%tile	595.84	12963.85		578.08	13945.40		0.31	8.30

TASK-A4 GROUNDWATER TRACER TEST

The purpose of the groundwater tracer test was to delineate eastern boundary of the Wakulla springshed by delineating the flow path(s) connecting one or more of the swallets located northeast of Tallahassee with the springs to which the rapidly recharged water at those locations discharges. These swallets include: Bird sink, Paddy sink, Copeland sink, Wood sink, Creek sink, and Lake Drain sink. Bird and Paddy sinks were estimated to be the largest of the swallets, and Bird sink is the only one of the group that has been explored by divers and found to connect to a large south-trending underwater cave system. It was explored by the Woodville Karst Plain Project prior to 2000 during which time they mapped approximately 1 mile of conduit trending south away from the sink. Because of these factors, Bird sink was the primary target for this study.

Prior to this test, the flow paths leading away from these swallets were the largest remaining karstic flow paths in the western Woodville Karst Plain that had not been traced. The pathways must be defined in the groundwater flow model that we have been developing for the Woodville Karst Plain and, in previous versions of the model, had been assumed to connect solely to the St. Marks River rise.

There are three reasonably probable spring groups to which the water from these swallets would likely flow: Wacissa, located approximately 10.6 miles southeast of Bird sink; the St. Marks River rise, located approximately 15.5 miles south-southwest of Bird sink; and Wakulla spring, located approximately 23.5 miles southwest of Bird sink. All of these locations were regularly sampled for the injected tracer during the study period. Wacissa was sampled at Big Blue spring and a point in the Wacissa River approximately 100 yards upstream from the confluence between the Big Blue outflow and the river. The St. Marks River was sampled at numerous locations including: Horn spring, Natural Bridge sink, Rhodes spring, and the River rise. Wakulla spring was sampled at the spring vent. Figure 8 shows the locations of the swallets relative to the St. Marks and Wakulla rivers.

The potential St. Marks and Wakulla flow paths are significantly longer than any pathway traced to date in the Woodville Karst Plain, where the longest traced pathway was between the City of Tallahassee's southeast sprayfield and Wakulla spring at approximately 12 miles. That trace produced significant but low-concentration recovery curves for both uraninie and eosine, which were injected into wells and a swallet respectively. For that reason and the potential that the injected tracer would travel to Wakulla, the longest flow path, it was decided to focus on Bird sink as a solitary injection using a single large quantity slug injection.

The tracer injection was performed on February 22, 2012 under nearly ideal hydraulic conditions, a rising stage in the swallet immediately following a moderate precipitation event. The injection occurred at such a late date because we endeavored to wait for such conditions, which were rare during the previous 18 months due to dry conditions in north Florida. Bird sink was in fact dry for much of that previous time period.

Once the stage began to rise and we were confident that it would continue to rise for one or more days, 18 5-gallon pales of liquid uranine dye were released into the flowing water immediately upstream of the swallet. The liquid was 36% dye creating a slug injection of 220 lbs.

Sampling began approximately two weeks prior to the injection at all locations. The stations at Big Blue, the Wacissa River, the St. Marks River rise, and Wakulla spring were configured with automatic water samplers set to collect one sample every 12 hours. Grab samples were collected on a weekly basis at the other locations. Tracer detections were recorded at Horn spring, Natural Bridge sink, and Rhodes spring at levels well within the visible range. The tracer was also detected at Wakulla spring, though at very small concentrations. The tracer was not detected at either of the Wacissa stations. The traced flow paths are shown on figure 8. Figure 9 provides the tracer recovery curves produced from the samples collected and analyzed at the stations where the tracer was detected. Appendix I provides the tracer concentrations derived from spectrofluorophotometric analysis.

Travel times were calculated based on the peak of the recovery curves. Table 10 provides the results, which reveal the fastest travel times recorded in the Woodville Karst Plain. Based on these results, we conclude that groundwater flow through this region of the Floridan aquifer is highly concentrated into the conduits, despite traveling under parts of the confined portion of the aquifer, where the flow velocity is driven by large head gradients created when the swallets are filled.

The estimated groundwater velocity to Wakulla Spring was approximately 5 times faster than the velocities recorded during the City of Tallahassee sprayfield test. We hypothesize that these results are more reflective of the extremely fast travel time from Bird Sink to the edge of the confining unit (proximal to the sprayfield) and that the actual travel time along the pathway from there to Wakulla is similar to that recorded in the sprayfield traces.

Table 10. Distances, travel times, and groundwater velocities recorded and calculated from the Bird Sink tracer test results.

Location	Straight-line Distance from Injection (miles)	Date of Peak Arrival	Travel Time (days)	Minimum Groundwater Velocity (ft/day)
Horn Spring	12.5	3/5/2012 10:16	11.78	5601.79
Rhodes Spring	15.2	3/6/2012 15:40	13.01	6170.24
St. Marks River Rise	15.5	3/7/2012 7:00	13.65	5997.44
Natural Bridge Sink	15.2	3/6/2012 15:25	13.00	6175.19
Wakulla Spring	23.2	4/14/2012 18:15	52.11	2350.51

The Bird Sink tracer test produced important data about groundwater flow through the upper Floridan aquifer. It revealed unequivocally that flow directions and velocities are controlled by karstic conduits even under the confining unit and well north of the transition zone between confined and unconfined conditions. In short, the trace demonstrated that swallets feed conduits that transport the water rapidly to springs. The primary pathway was to the St. Marks group of discharges, which confirmed our hypothesis and establishes the eastern boundary of the Wakulla springshed along a northeast-southwest line between the City of Tallahassee sprayfield and the upper St. Marks River.

Finally, the low-concentration detections at Wakulla spring demonstrate that water from the conduit flow paths must overflow into secondary conduits leading to competing springs. This same type of overflow was recorded during the sprayfield trace wherein low-concentration detections were recorded at McBride's, Indian, and Sally ward springs, which presumably resulted from overflow out of the primary pathway connecting to Wakulla B-Tunnel.

TASK-A2 GROUNDWATER MODEL REVISION

The purpose of this task was to use the numerical karst groundwater flow model (GWM) that had been developed in 2010 for the WKP to evaluate the impact of sea-level rise on groundwater flow patterns in the southern part of the WKP and to specifically quantify changes in the magnitude and distribution of groundwater flow to the Gulf of Mexico. Two factors were to be considered: 1) projected 50-year sea-level rise, and 2) current and predicted future groundwater extractions in the springsheds supplying fresh water to the coastal ecosystems, which include: Wakulla, Spring Creek, St. Marks, and Wacissa springs. The model was also to be updated to account for conduit flow pathways and velocities determined through the groundwater tracing performed under Task-A4.

The 2009 model was adequately calibrated to head and spring flow data but did not include groundwater pumping. At the outset of this task, our analysis of pumping in north Florida and south Georgia revealed significantly more extractions than were anticipated. Once the pumping data was compiled and entered into the model, we found that the 2010 calibration was inadequate. Revising the model calibration required a closer scrutiny and interpretation of the geologic framework on which the groundwater model was constructed. We began that process and successfully revised our interpretations of the geology but time and budget prohibited the necessary recalibration before the planned scenario analyses could be performed.

In this report, we will therefore summarize the work that was completed: compilation of pumping data and reinterpretation of the geologic framework, and provide a list of the remaining tasks required in order to produce scenario analyses designed to evaluate the impact of sea level rise. A detailed description of the model as it was constructed in 2010 is provided by GeoHydros (2010).

PUMPING

An accurate understanding of the magnitude, location, and hydrostratigraphic source of groundwater pumping is crucial to the development of an accurate water budget and therefore a reliable numerical groundwater flow model. Previous modeling studies, including ours and Davis (1994) had not addressed pumping in a comprehensive manner. Our effort therefore began by compiling, analyzing, and sorting pumping data from Federal, State, and County resources. The data was broken out and will be described here in three categories: agricultural, municipal, and other.

Agricultural

Agricultural groundwater pumping data has been compiled and broken out by land use by collaborative efforts conducted by universities and State agencies in both Georgia and Florida. For Georgia, the most comprehensive data and accounting is available from The National Environmentally Sound Production Agriculture Laboratory (NESPAL) unit of the University of Georgia's College of Agricultural and Environmental Sciences (NESPAL, 2012[a]; NESPAL, 2012[b]). For Florida, the most comprehensive data is maintained by the Northwest Florida Water Management District (NFWMD) and the Suwannee River Water Management District (SRWMD). Both the Georgia and Florida datasets were compiled for the Floridan aquifer. For this effort, the data was processed in total (aquifer-wide) and then parsed into datasets pertaining to the GWM domain (Table 11). Table 12 summarizes the distribution and magnitude of agricultural pumping in the Georgia Counties intersected by the GWM domain along with the hydrostratigraphic units from which the water is derived. \

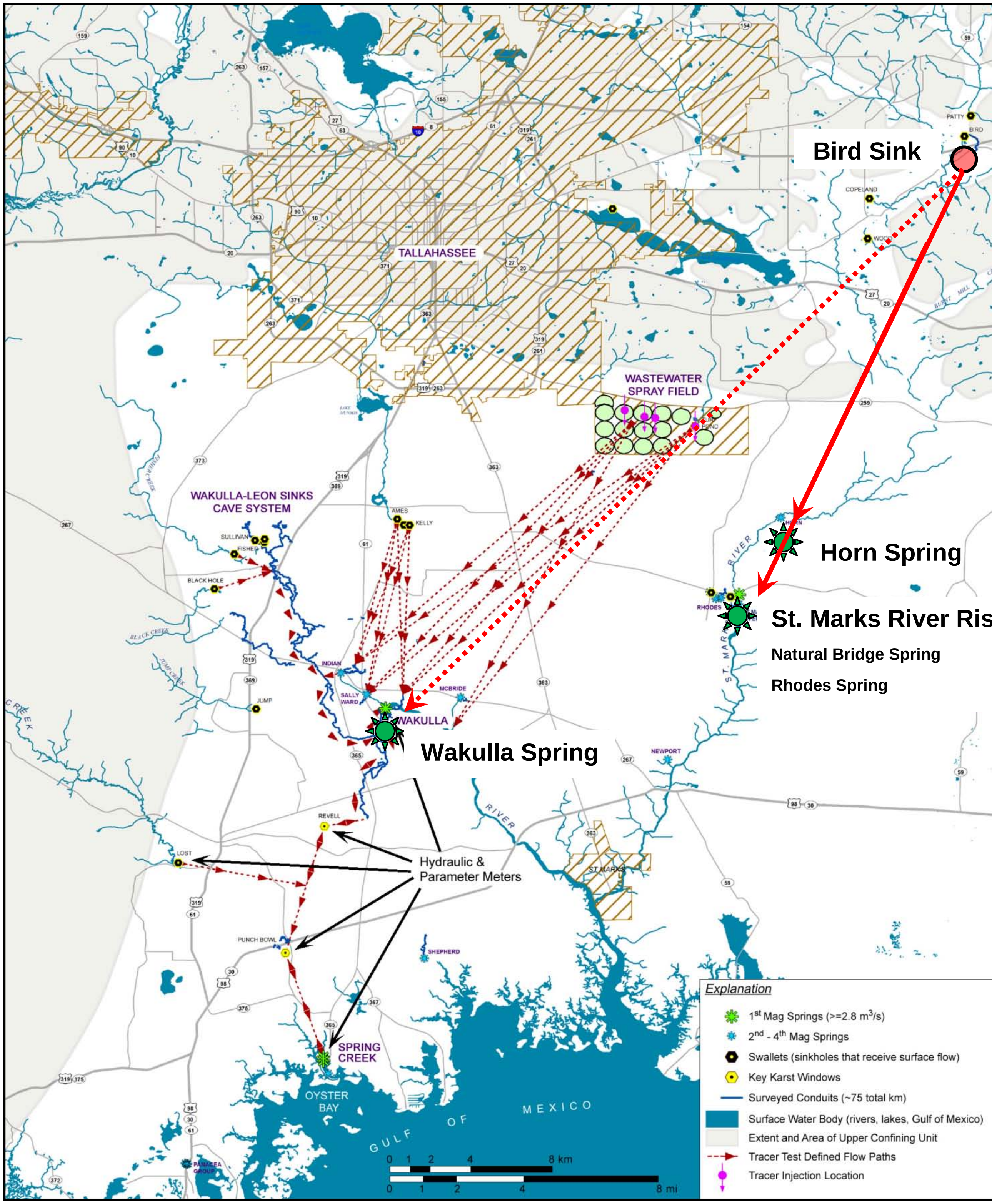
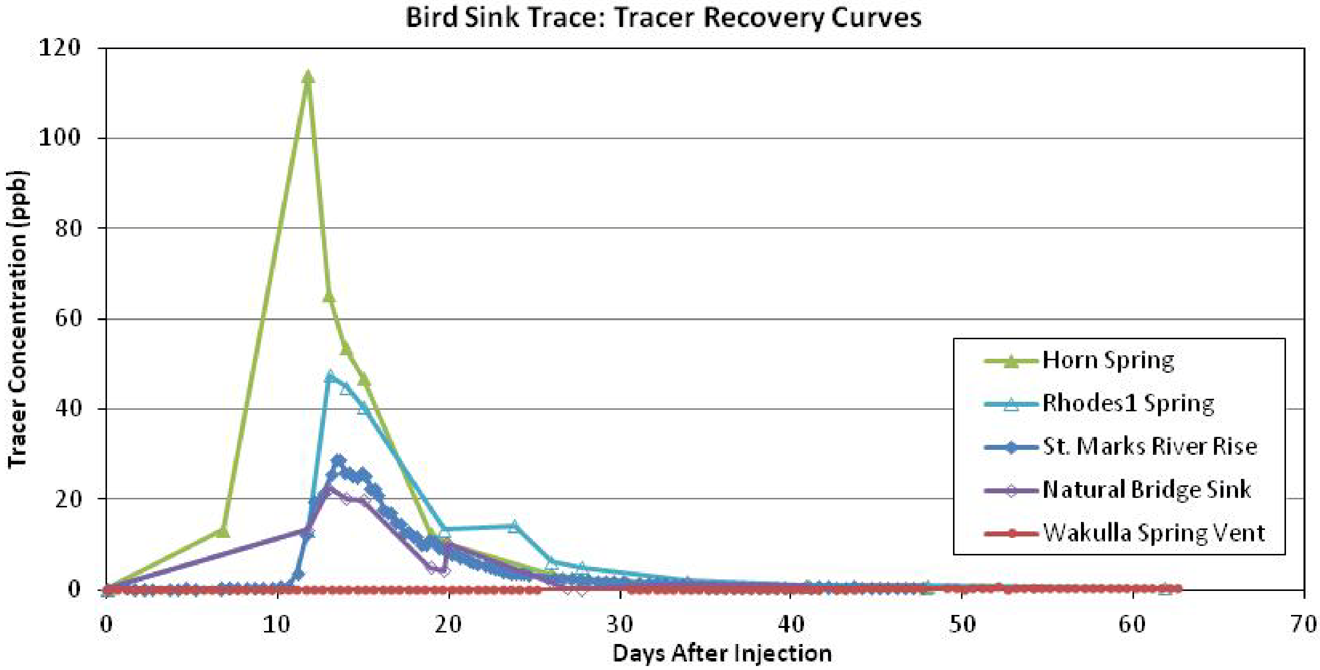


Figure 8. Map of the western Woodville Karst Plain showing the location of the Bird Sink tracer test injection (large red dot) and the sampled springs where the tracer was recovered (Horn spring, St. Marks River Rise, Natural Bridge spring, Rhodes spring, and Wakulla spring) relative to projected straight-line flow paths. Note that the heavy solid red line marks the primary flow path, the heavy dashed red line marks a secondary path, and the thinner dashed maroon lines mark previously defined traced flow paths.



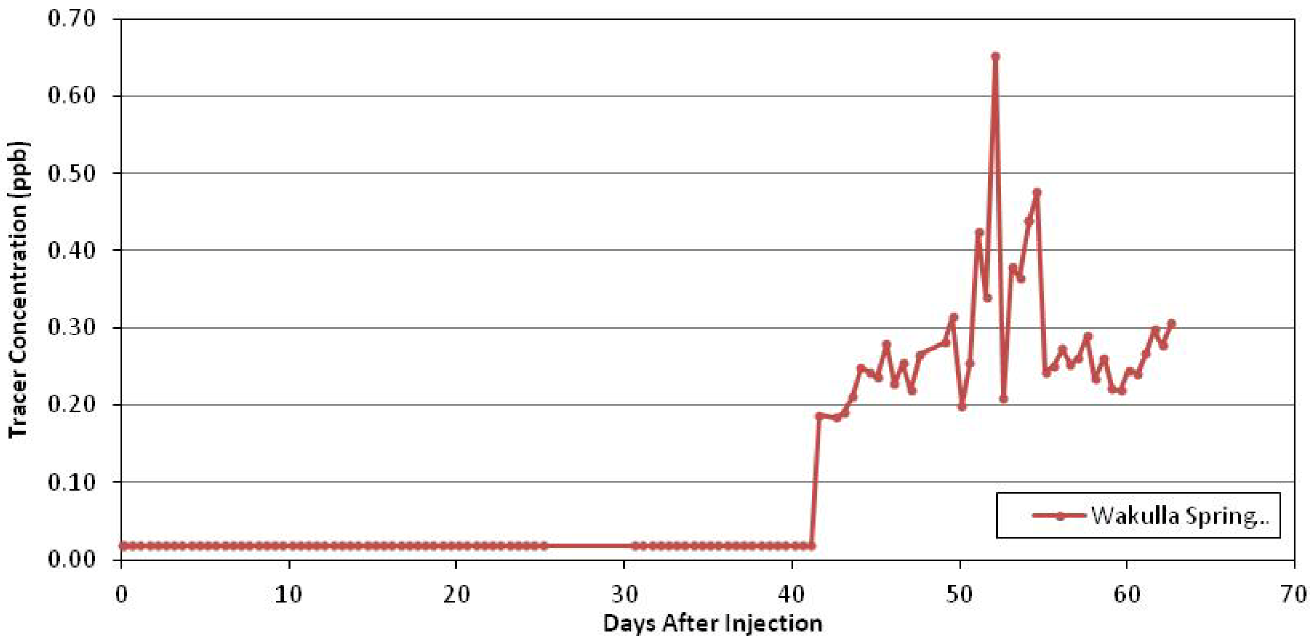


Figure 9. Tracer recovery curves from the monitored stations where dye was detected during the Bird Sink groundwater tracer test. Top plot shows all curves. Bottom plot shows an expanded view of the recovery curve produced from samples collected at the Wakulla spring vent.

APPENDIX I
BIRD SINK GROUNDWATER TRACER TEST - TRACER RECOVERY DATA

Horn Spring

FILENAME	Date and Time	Days from injection	Baseline	Uranine Wavelength	Uranine Amplitude	Uranine Adjusted	Uranine Conc. (ppb)
Injection	2/22/2012 15:30	0.00	no dye	-	-	0.018	0.203
1870.txt	2/29/2012 11:08	6.82	0.003	516	0.115	8.050	13.188
1871.txt	3/5/2012 10:16	11.78	-0.009	513.6	54.222	3795.540	113.866
1872.txt	3/6/2012 14:40	12.97	-0.001	513.6	31.046	2173.220	65.197
1873.txt	3/7/2012 14:52	13.97	0.008	513.6	25.510	1785.700	53.571
1874.txt	3/8/2012 15:33	15.00	0.010	513.6	22.337	1563.590	46.908
1875.txt	3/12/2012 13:33	18.92	0.012	512.8	5.975	418.250	12.548
1876.txt	3/13/2012 13:12	19.90	0.010	513.6	4.870	340.900	10.227
2127.txt	3/19/2012 13:35	25.92	1.100	513.6	118.341	117.241	3.517
2128.txt	3/21/2012 10:24	27.79	1.326	514.4	82.486	81.160	2.435
2129.txt	3/27/2012 13:17	33.91	1.294	514.4	42.956	41.662	1.250
2130.txt	4/3/2012 15:55	41.02	1.317	514.4	23.137	21.820	0.655
2131.txt	4/10/2012 12:30	47.88	0.930	510.4	8.019	7.089	0.213

Natural Bridge Sink

FILENAME	Date and Time	Days from injection	Baseline	Uranine Wavelength	Uranine Amplitude	Uranine Adjusted	Uranine Conc. (ppb)
Injection	2/22/2012 15:30	0.00	no dye	-	-	0.018	0.203
1877.txt	3/5/2012 10:15	11.78	0.016	513.6	12.364	865.480	13.188
1878.txt	3/6/2012 15:25	13.00	0.000	513.6	10.748	752.360	22.571
1879.txt	3/7/2012 15:25	14.00	0.002	513.6	9.584	670.880	20.126
1880.txt	3/8/2012 15:20	14.99	0.006	513.6	9.404	658.280	19.748
1881.txt	3/12/2012 13:16	18.91	0.004	512	2.376	166.320	4.990
1882.txt	3/13/2012 9:15	19.74	-0.007	513.6	1.987	139.090	4.173
1876.txt	3/13/2012 13:12	19.90	0.010	513.6	4.870	340.900	10.227
2137.txt	3/19/2012 13:41	25.92	1.522	513.6	57.257	55.735	1.672
2138.txt	3/20/2012 12:53	26.89	1.311	510.4	11.815	10.504	0.315
2139.txt	3/21/2012 10:05	27.77	1.324	514.4	5.129	3.805	0.114
2140.txt	3/27/2012 13:42	33.92	1.122	513.6	45.728	44.606	1.338
2141.txt	4/3/2012 12:29	40.87	1.341	511.2	27.385	26.044	0.781

Rhodes1 Spring

FILENAME	Date and Time	Days from injection	BASELINE	URAN_WAVE	URAN_AMP	URAN_ADJ	AY73ppb
Injection	2/22/2012 15:30	0.00	no dye			0.018	0.203
1852.txt	3/5/2012 9:37	11.75	-0.011	513.6	6.301	441.070	13.232
1853.txt	3/6/2012 15:40	13.01	-0.007	513.6	22.665	1586.550	47.597
1857.txt	3/7/2012 15:30	14.00	0.006	513.6	21.392	1497.440	44.923
1854.txt	3/8/2012 15:10	14.99	0.000	513.6	19.332	1353.240	40.597
1855.txt	3/13/2012 9:10	19.74	-0.012	512.8	6.302	441.140	13.234
1856.txt	3/17/2012 11:40	23.84	-0.004	513.6	6.779	474.530	14.236
2112.txt	3/19/2012 14:54	25.97	1.272	513.6	208.150	206.878	6.206
2113.txt	3/21/2012 9:50	27.76	1.240	514.4	164.049	162.809	4.884
2114.txt	3/27/2012 13:51	33.93	1.234	512.8	64.289	63.055	1.892
2115.txt	4/3/2012 13:56	40.93	1.747	510.4	31.063	29.316	0.879
2116.txt	4/10/2012 14:45	47.97	2.019	510.4	27.906	25.887	0.777
2198.txt	4/24/2012 12:09	61.86	1.155	514.4	8.853	7.698	0.231

St. Marks River Rise

FILENAME	Date and Time	Days from injection	Baseline	Uranine Wavelength	Uranine Amplitude	Uranine Adjusted	Uranine Conc. (ppb)
Injection	2/22/2012 15:30	0.00	no dye			0.018	0.203
1671.txt	2/22/2012 7:00	-0.35	1.081	511.2	7.864	6.783	0.203
1672.txt	2/23/2012 19:00	1.15	0.994	510.4	8.520	7.526	0.226
1673.txt	2/24/2012 7:00	1.65	1.137	510.4	7.406	6.269	0.188
1674.txt	2/24/2012 19:00	2.15	1.110	516	8.068	6.958	0.209
1675.txt	2/24/2012 7:00	1.65	1.152	511.2	7.322	6.170	0.185
1676.txt	2/24/2012 19:00	2.15	1.025	510.4	7.287	6.262	0.188
1676.txt	2/24/2012 19:00	2.15	1.025	510.4	7.287	6.262	0.188
1677.txt	2/25/2012 7:00	2.65	0.979	512	7.395	6.416	0.192
1679.txt	2/26/2012 7:00	3.65	1.066	510.4	7.061	5.995	0.180
1680.txt	2/26/2012 19:00	4.15	0.889	510.4	7.955	7.066	0.212
1681.txt	2/27/2012 7:00	4.65	0.959	510.4	9.531	8.572	0.257
1682.txt	2/27/2012 19:00	5.15	1.016	510.4	6.671	5.655	0.170
1683.txt	2/29/2012 7:00	6.65	1.051	512	7.366	6.315	0.189
1684.txt	2/29/2012 19:00	7.15	1.096	510.4	8.769	7.673	0.230
1685.txt	2/29/2012 7:00	6.65	1.065	510.4	8.946	7.881	0.236
1686.txt	2/29/2012 19:00	7.15	1.211	511.2	8.425	7.214	0.216
1685.txt	2/29/2012 7:00	6.65	1.065	510.4	8.946	7.881	0.236
1686.txt	2/29/2012 19:00	7.15	1.211	511.2	8.425	7.214	0.216
1687.txt	3/1/2012 7:00	7.65	1.230	510.4	10.394	9.164	0.275
1688.txt	3/1/2012 19:00	8.15	1.203	511.2	8.890	7.687	0.231
1689.txt	3/2/2012 7:00	8.65	1.335	510.4	9.017	7.682	0.230
1690.txt	3/2/2012 19:00	9.15	1.315	510.4	8.628	7.313	0.219
1691.txt	3/3/2012 7:00	9.65	1.146	510.4	9.645	8.499	0.255
1692.txt	3/3/2012 19:00	10.15	1.390	510.4	23.965	22.575	0.677
1693.txt	3/4/2012 7:00	10.65	1.204	510.4	27.908	26.704	0.801
1694.txt	3/4/2012 19:00	11.15	1.268	513.6	123.547	122.279	3.668
1695.txt	3/5/2012 7:00	11.65	1.411	513.6	405.730	404.319	12.130
1696.txt	3/5/2012 19:00	12.15	1.542	514.4	652.453	650.911	19.527
1697.txt	3/6/2012 7:00	12.65	0.026	513.6	10.096	706.720	21.202
1698.txt	3/6/2012 19:00	13.15	0.029	512.8	12.201	854.070	25.622
1699.txt	3/7/2012 1:00	13.40	0.011	513.6	13.669	956.830	28.705
1700.txt	3/7/2012 7:00	13.65	0.025	513.6	13.724	960.680	28.820
1701.txt	3/7/2012 13:00	13.90	0.014	513.6	12.308	861.560	25.847
1702.txt	3/7/2012 19:00	14.15	0.011	513.6	12.326	862.820	25.885
1703.txt	3/8/2012 1:00	14.40	0.009	513.6	12.096	846.720	25.402
1704.txt	3/8/2012 7:00	14.65	-0.015	513.6	11.857	829.990	24.900
1705.txt	3/8/2012 13:00	14.90	1.709	515.2	862.734	861.025	25.831
1706.txt	3/8/2012 19:00	15.15	1.351	515.2	843.601	842.250	25.268
1707.txt	3/9/2012 1:00	15.40	1.014	514.4	748.198	747.184	22.416
1708.txt	3/9/2012 7:00	15.65	1.263	514.4	745.659	744.396	22.332
1709.txt	3/9/2012 13:00	15.90	1.352	514.4	704.251	702.899	21.087
1710.txt	3/9/2012 19:00	16.15	1.664	514.4	598.562	596.898	17.907
1711.txt	3/10/2012 1:00	16.40	1.209	514.4	571.210	570.001	17.100
1712.txt	3/10/2012 7:00	16.65	1.095	514.4	571.618	570.523	17.116
1713.txt	3/10/2012 13:00	16.90	1.353	513.6	502.524	501.171	15.035
1714.txt	3/10/2012 19:00	17.15	1.415	515.2	486.974	485.559	14.567
1715.txt	3/11/2012 1:00	17.40	1.560	514.4	420.404	418.844	12.565
1716.txt	3/11/2012 7:00	17.65	1.195	514.4	429.782	428.587	12.858
1717.txt	3/11/2012 13:00	17.90	1.648	514.4	397.762	396.114	11.883
1718.txt	3/11/2012 19:00	18.15	1.335	513.6	387.755	386.420	11.593
1719.txt	3/12/2012 1:00	18.40	1.696	513.6	338.627	336.931	10.108
1720.txt	3/12/2012 7:00	18.65	1.293	513.6	337.522	336.229	10.087
1955.txt	3/12/2012 13:00	18.90	1.599	514.4	371.141	369.542	11.086
1956.txt	3/12/2012 19:00	19.15	1.475	513.6	354.007	352.532	10.576
1957.txt	3/13/2012 1:00	19.40	1.018	513.6	306.927	305.909	9.177

St. Marks River Rise

FILENAME	Date and Time	Days from injection	Baseline	Uranine Wavelength	Uranine Amplitude	Uranine Adjusted	Uranine Conc. (ppb)
1958.txt	3/13/2012 7:00	19.65	1.412	514.4	308.725	307.313	9.219
1959.txt	3/13/2012 13:00	19.90	1.245	513.6	290.359	289.114	8.673
1960.txt	3/13/2012 19:00	20.15	1.192	515.2	268.128	266.936	8.008
1961.txt	3/14/2012 1:00	20.40	1.394	513.6	262.409	261.015	7.830
1962.txt	3/14/2012 7:00	20.65	1.801	514.4	245.035	243.234	7.297
1963.txt	3/14/2012 13:00	20.90	1.484	513.6	240.675	239.191	7.176
1964.txt	3/14/2012 19:00	21.15	1.455	513.6	219.622	218.167	6.545
1965.txt	3/15/2012 1:00	21.40	1.506	513.6	204.174	202.668	6.080
1966.txt	3/15/2012 7:00	21.65	1.285	514.4	195.393	194.108	5.823
1967.txt	3/15/2012 19:00	22.15	1.275	513.6	175.078	173.803	5.214
1968.txt	3/16/2012 1:00	22.40	1.141	514.4	169.055	167.914	5.037
1969.txt	3/16/2012 7:00	22.65	1.462	513.6	162.104	160.642	4.819
1970.txt	3/16/2012 13:00	22.90	1.326	513.6	150.873	149.547	4.486
1971.txt	3/16/2012 19:00	23.15	1.233	513.6	135.952	134.719	4.042
1972.txt	3/17/2012 1:00	23.40	1.265	513.6	130.604	129.339	3.880
1973.txt	3/17/2012 7:00	23.65	1.365	512.8	125.436	124.071	3.722
1974.txt	3/17/2012 13:00	23.90	1.123	512.8	119.124	118.990	3.570
1975.txt	3/17/2012 19:00	24.15	1.134	512.8	116.124	114.990	3.450
1976.txt	3/18/2012 1:00	24.40	1.327	514.4	116.614	115.287	3.459
1977.txt	3/18/2012 7:00	24.65	1.333	513.6	112.884	111.551	3.347
1978.txt	3/19/2012 19:00	26.15	1.453	513.6	90.200	88.747	2.662
1979.txt	3/20/2012 7:00	26.65	1.408	512.8	91.114	89.700	2.691
1980.txt	3/20/2012 19:00	27.15	1.335	512	83.858	82.523	2.476
1981.txt	3/21/2012 7:00	27.65	1.180	513.6	79.059	77.879	2.336
1982.txt	3/21/2012 19:00	28.15	1.282	512.8	70.420	69.138	2.074
1983.txt	3/22/2012 7:00	28.65	1.561	511.2	65.181	63.620	1.909
1984.txt	3/22/2012 19:00	29.15	1.092	512.8	61.875	60.780	1.823
1985.txt	3/23/2012 7:00	29.65	1.140	512.8	64.016	62.876	1.886
1986.txt	3/23/2012 19:00	30.15	1.392	515.2	56.770	55.378	1.661
1987.txt	3/24/2012 1:00	30.40	1.650	513.6	54.087	52.437	1.573
1988.txt	3/24/2012 19:00	31.15	1.329	513.6	48.789	47.460	1.424
1989.txt	3/25/2012 7:00	31.65	1.566	512	49.045	47.479	1.424
1990.txt	3/25/2012 19:00	32.15	1.789	512	48.161	46.372	1.391
1991.txt	3/26/2012 7:00	32.65	1.169	514.4	49.437	48.268	1.448
1992.txt	3/26/2012 19:00	33.15	1.119	511.2	38.862	37.743	1.132
1993.txt	3/27/2012 7:00	33.65	1.202	512	39.771	38.569	1.157
1994.txt	3/27/2012 19:00	34.15	1.227	510.4	21.703	20.476	0.614
1995.txt	3/28/2012 7:00	34.65	0.967	512	19.915	18.948	0.568
1996.txt	3/28/2012 19:00	35.15	1.047	512	17.660	16.613	0.498
1997.txt	3/29/2012 7:00	35.65	1.124	510.4	18.625	17.501	0.525
1998.txt	3/29/2012 19:00	36.15	0.998	512.8	16.437	15.439	0.463
1999.txt	3/30/2012 7:00	36.65	1.072	512	15.686	14.614	0.438
2000.txt	3/30/2012 19:00	37.15	1.349	512.8	15.703	14.354	0.431
2001.txt	3/31/2012 7:00	37.65	0.982	513.6	16.217	15.235	0.457
2002.txt	3/31/2012 19:00	38.15	1.413	514.4	12.367	10.954	0.329
2003.txt	4/1/2012 7:00	38.65	1.107	510.4	12.577	11.470	0.344
2004.txt	4/1/2012 19:00	39.15	1.131	514.4	11.101	9.970	0.299
2005.txt	4/2/2012 7:00	39.65	1.366	512	14.049	12.683	0.380
2006.txt	4/3/2012 19:00	41.15	1.252	515.2	11.910	10.650	0.320
2007.txt	4/4/2012 7:00	41.65	1.025	512	12.887	11.862	0.356
2008.txt	4/4/2012 19:00	42.15	1.271	513.6	20.260	18.980	0.569
2009.txt	4/4/2012 7:00	41.65	1.007	511.2	21.090	20.080	0.602
2010.txt	4/4/2012 19:00	42.15	1.172	512.8	15.817	14.645	0.439
2011.txt	4/5/2012 7:00	42.65	1.144	514.4	18.975	17.831	0.535
2012.txt	4/5/2012 19:00	43.15	1.138	510.4	17.308	16.170	0.485
2013.txt	4/6/2012 7:00	43.65	1.290	512	25.350	24.060	0.722

St. Marks River Rise

FILENAME	Date and Time	Days from injection	Baseline	Uranine Wavelength	Uranine Amplitude	Uranine Adjusted	Uranine Conc. (ppb)
2014.txt	4/6/2012 19:00	44.15	1.245	511.2	18.059	16.814	0.504
2015.txt	4/7/2012 7:00	44.65	1.386	514.4	17.141	15.755	0.473
2016.txt	4/7/2012 19:00	45.15	1.353	512.8	15.667	14.314	0.429
2017.txt	4/8/2012 7:00	45.65	1.309	512	15.730	14.421	0.433
2018.txt	4/8/2012 19:00	46.15	1.330	514.4	15.866	14.536	0.436
2019.txt	4/9/2012 7:00	46.65	1.328	512.8	15.053	13.725	0.412
2020.txt	4/9/2012 19:00	47.15	1.328	515.2	17.322	15.994	0.480
2021.txt	4/10/2012 7:00	47.65	1.516	510.4	15.400	13.884	0.417

Wakulla Spring Vent

FILENAME	Date and Time	Days from injection	BASELINE	URAN_WAVE	URAN_AMP	URAN_ADJ	AY73ppb
Injection	2/22/2012 15:30	0.00	no dye	-	-	0.018	0.018
1721.txt	2/21/2012 6:15	-1.39	1.751	511.2	12.544	10.793	0.018
1722.txt	2/21/2012 18:15	-0.89	1.733	510.4	11.238	9.505	0.018
1723.txt	2/22/2012 6:15	-0.39	1.569	510.4	8.831	7.262	0.018
1724.txt	2/22/2012 18:15	0.11	1.575	514.4	12.307	10.732	0.018
1725.txt	2/23/2012 6:15	0.61	1.704	510.4	9.211	7.507	0.018
1726.txt	2/23/2012 18:15	1.11	1.528	511.2	8.181	6.653	0.018
1727.txt	2/24/2012 6:15	1.61	1.888	516	9.279	7.391	0.018
1728.txt	2/24/2012 18:15	2.11	1.664	511.2	10.062	8.390	0.018
1729.txt	2/25/2012 6:15	2.61	1.288	510.4	12.740	11.450	0.018
1730.txt	2/25/2012 18:15	3.11	1.336	510.4	9.974	8.638	0.018
1731.txt	2/26/2012 6:15	3.61	1.718	510.4	11.520	9.802	0.018
1732.txt	2/26/2012 18:15	4.11	1.862	510.4	10.838	8.976	0.018
1733.txt	2/27/2012 6:15	4.61	1.506	510.4	9.936	8.430	0.018
1734.txt	2/27/2012 18:15	5.11	1.836	510.4	10.580	8.744	0.018
1735.txt	2/28/2012 6:15	5.61	1.537	510.4	14.307	12.700	0.018
1736.txt	2/28/2012 18:15	6.11	1.726	512	8.264	6.538	0.018
1737.txt	2/29/2012 6:15	6.61	1.843	512	8.352	6.509	0.018
1738.txt	2/29/2012 18:15	7.11	1.641	513.6	6.941	5.300	0.018
1739.txt	3/1/2012 6:15	7.61	1.395	516	6.523	5.128	0.018
1740.txt	3/1/2012 18:15	8.11	1.479	516	5.986	4.507	0.018
1741.txt	3/2/2012 6:15	8.61	1.519	511.2	6.484	4.900	0.018
1742.txt	3/2/2012 18:15	9.11	1.364	511.2	6.588	5.224	0.018
1743.txt	3/3/2012 6:15	9.61	1.387	511.2	6.434	5.047	0.018
1744.txt	3/3/2012 18:15	10.11	1.442	513.6	6.840	5.398	0.018
1745.txt	3/4/2012 6:15	10.61	1.741	514.4	7.041	5.300	0.018
1746.txt	3/4/2012 18:15	11.11	1.396	514.4	6.943	5.547	0.018
1747.txt	3/5/2012 6:15	11.61	1.519	511.2	6.209	4.690	0.018
1748.txt	3/5/2012 18:15	12.11	1.419	510.4	7.946	6.527	0.018
1749.txt	3/6/2012 6:15	12.61	1.508	512.8	7.865	6.357	0.018
1750.txt	3/6/2012 18:15	13.11	1.708	510.4	8.174	6.466	0.018
1751.txt	3/7/2012 6:15	13.61	1.814	510.4	8.526	6.712	0.018
1752.txt	3/7/2012 18:15	14.11	1.592	510.4	8.325	6.733	0.018
1753.txt	3/8/2012 6:15	14.61	1.346	512.8	9.645	8.299	0.018
1754.txt	3/8/2012 18:15	15.11	1.625	512	13.187	11.562	0.018
1755.txt	3/9/2012 6:15	15.61	1.500	510.4	7.116	5.616	0.018
1756.txt	3/9/2012 18:15	16.11	1.644	515.2	6.832	5.188	0.018
1757.txt	3/10/2012 6:15	16.61	1.483	512.8	7.393	5.910	0.018
1758.txt	3/10/2012 18:15	17.11	1.514	516	6.361	4.847	0.018
1759.txt	3/11/2012 6:15	17.61	1.520	510.4	6.155	4.635	0.018
1760.txt	3/11/2012 18:15	18.11	1.629	510.4	8.209	6.580	0.018
1761.txt	3/12/2012 6:15	18.61	1.398	512	8.776	7.378	0.018
1762.txt	3/12/2012 18:15	19.11	1.742	514.4	8.712	6.970	0.018
1763.txt	3/13/2012 6:15	19.61	1.405	510.4	8.297	6.890	0.018
1899.txt	3/13/2012 18:15	20.11	1.564	524	6.479	4.915	0.018
1900.txt	3/14/2012 6:15	20.61	1.271	512.8	8.117	6.800	0.018
1901.txt	3/14/2012 18:15	21.11	1.298	514.4	7.134	5.800	0.018
1902.txt	3/15/2012 6:15	21.61	1.468	510.4	6.413	4.945	0.018
1903.txt	3/15/2012 18:15	22.11	1.443	511.2	7.667	6.224	0.018
1904.txt	3/16/2012 6:15	22.61	1.185	514.4	9.249	8.064	0.018

Wakulla Spring Vent

FILENAME	Date and Time	Days from injection	BASELINE	URAN_WAVE	URAN_AMP	URAN_ADJ	AY73ppb
1905.txt	3/16/2012 18:15	23.11	1.345	516	6.455	5.110	0.018
1906.txt	3/17/2012 6:15	23.61	1.509	510.4	7.229	5.720	0.018
1907.txt	3/17/2012 18:15	24.11	1.063	515.2	7.357	6.294	0.018
1908.txt	3/18/2012 6:15	24.61	1.318	511.2	7.176	5.858	0.018
1909.txt	3/18/2012 18:15	25.11	1.599	514.4	7.916	6.317	0.018
1920.txt	3/24/2012 6:15	30.61	1.062	517.6	7.370	6.308	0.018
1921.txt	3/24/2012 18:15	31.11	1.278	510.4	9.264	7.986	0.018
1922.txt	3/25/2012 6:15	31.61	1.367	510.4	8.538	7.171	0.018
1923.txt	3/25/2012 18:15	32.11	1.229	512.8	6.034	4.805	0.018
1924.txt	3/26/2012 6:15	32.61	1.508	510.4	5.030	3.522	0.018
1925.txt	3/26/2012 18:15	33.11	1.310	517.6	4.930	3.620	0.018
1926.txt	3/27/2012 6:15	33.61	1.599	510.4	5.459	3.860	0.018
1927.txt	3/27/2012 18:15	34.11	1.545	513.6	6.488	4.943	0.018
1928.txt	3/28/2012 6:15	34.61	1.114	510.4	7.533	6.419	0.018
1929.txt	3/28/2012 18:15	35.11	1.358	513.6	4.811	3.453	0.018
1930.txt	3/29/2012 6:15	35.61	1.310	510.4	5.320	4.010	0.018
1931.txt	3/29/2012 18:15	36.11	1.309	517.6	5.385	4.076	0.018
1932.txt	3/30/2012 6:15	36.61	1.378	510.4	5.584	4.206	0.018
1933.txt	3/30/2012 18:15	37.11	1.252	516.8	5.299	4.047	0.018
1934.txt	3/31/2012 6:15	37.61	1.490	511.2	7.642	6.152	0.018
1935.txt	3/31/2012 18:15	38.11	1.450	510.4	7.745	6.295	0.018
1936.txt	4/1/2012 6:15	38.61	1.364	518.4	6.100	4.736	0.018
1937.txt	4/1/2012 18:15	39.11	1.440	512.8	6.963	5.523	0.018
1938.txt	4/2/2012 6:15	39.61	1.301	515.2	5.801	4.500	0.018
1939.txt	4/2/2012 18:15	40.11	1.318	510.4	8.069	6.751	0.018
1940.txt	4/3/2012 6:15	40.61	1.208	519.2	6.604	5.396	0.018
1941.txt	4/3/2012 18:15	41.11	1.346	511.2	12.171	10.825	0.018
1942.txt	4/4/2012 6:15	41.61	1.212	511.2	7.446	6.234	0.187
1944.txt	4/5/2012 6:15	42.61	1.183	510.4	7.312	6.129	0.184
1945.txt	4/5/2012 18:15	43.11	1.345	511.2	7.691	6.346	0.190
1946.txt	4/6/2012 6:15	43.61	1.279	512.8	8.351	7.072	0.212
1947.txt	4/6/2012 18:15	44.11	1.446	512	9.725	8.279	0.248
1948.txt	4/7/2012 6:15	44.61	1.365	512	9.470	8.105	0.243
1949.txt	4/7/2012 18:15	45.11	1.516	510.4	9.363	7.847	0.235
1950.txt	4/8/2012 6:15	45.61	1.255	511.2	10.569	9.314	0.279
1951.txt	4/8/2012 18:15	46.11	1.372	513.6	8.964	7.592	0.228
1952.txt	4/9/2012 6:15	46.61	1.456	512	9.926	8.470	0.254
1953.txt	4/9/2012 18:15	47.11	1.093	514.4	8.392	7.299	0.219
1954.txt	4/10/2012 6:15	47.61	1.366	510.4	10.231	8.865	0.266
2154.txt	4/11/2012 18:15	49.11	0.711	510.4	10.075	9.364	0.281
2155.txt	4/12/2012 6:15	49.61	1.015	511.2	11.498	10.483	0.314
2156.txt	4/12/2012 18:15	50.11	0.817	510.4	7.473	6.656	0.200
2157.txt	4/13/2012 6:15	50.61	1.161	513.6	9.633	8.472	0.254
2158.txt	4/13/2012 18:15	51.11	1.137	518.4	15.289	14.152	0.425
2159.txt	4/14/2012 6:15	51.61	1.153	510.4	12.481	11.328	0.340
2160.txt	4/14/2012 18:15	52.11	1.639	510.4	23.376	21.737	0.652
2161.txt	4/15/2012 6:15	52.61	1.108	511.2	8.063	6.955	0.209
2162.txt	4/15/2012 18:15	53.11	1.433	511.2	14.068	12.635	0.379
2163.txt	4/16/2012 6:15	53.61	1.299	510.4	13.462	12.163	0.365
2164.txt	4/16/2012 18:15	54.11	1.633	516	16.256	14.623	0.439

Wakulla Spring Vent

FILENAME	Date and Time	Days from injection	BASELINE	URAN_WAVE	URAN_AMP	URAN_ADJ	AY73ppb
2164.txt	4/16/2012 18:15	54.11	1.633	516	16.256	14.623	0.439
2165.txt	4/17/2012 6:15	54.61	1.552	516	17.426	15.874	0.476
2166.txt	4/17/2012 18:15	55.11	1.354	510.4	9.450	8.096	0.243
2167.txt	4/18/2012 6:15	55.61	1.238	514.4	9.584	8.346	0.250
2168.txt	4/18/2012 18:15	56.11	1.392	512.8	10.487	9.095	0.273
2169.txt	4/19/2012 6:15	56.61	1.354	514.4	9.768	8.414	0.252
2170.txt	4/19/2012 18:15	57.11	1.172	512	9.906	8.734	0.262
2171.txt	4/20/2012 6:15	57.61	1.009	510.4	10.659	9.650	0.290
2172.txt	4/20/2012 18:15	58.11	1.254	512	9.046	7.792	0.234
2173.txt	4/21/2012 6:15	58.61	1.346	515.2	10.086	8.740	0.262
2174.txt	4/21/2012 18:15	59.11	1.160	512.8	8.542	7.382	0.221
2175.txt	4/22/2012 6:15	59.61	1.535	510.4	8.859	7.324	0.220
2176.txt	4/22/2012 18:15	60.11	1.328	513.6	9.483	8.155	0.245
2177.txt	4/23/2012 6:15	60.61	1.317	513.6	9.360	8.043	0.241
2178.txt	4/23/2012 18:15	61.11	1.549	514.4	10.439	8.890	0.267
2179.txt	4/24/2012 6:15	61.61	1.387	510.4	11.328	9.941	0.298
2180.txt	4/24/2012 18:15	62.11	1.359	510.4	10.592	9.233	0.277
2181.txt	4/25/2012 6:15	62.61	1.479	513.6	11.691	10.212	0.306