Priority Pollutant Screening at Select Springs within the Southwest Florida Water Management District

Summary Report

Prepared by the
Resource Data Section

Southwest Florida Water Management District

September 2003

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Introduction

In July 2002, the Resource Data section collected samples from 10 springs within the Southwest Florida Water Management District (SWFWMD) to be analyzed for priority pollutants. The springs included: Weeki Wachee Main spring, Sulphur springs, Lithia Main spring, Rainbow #1 and #6 springs, Bubbling spring, Chassahowitzka Main spring, Chassahowitzka #1 spring, Homosassa #3 spring, and Hunters spring.

Laboratory and Analyte List

The Florida Department of Environmental Protection (FDEP) was retained as the analyzing laboratory. The analyte list included the following parameters:

- Base Neutral/Acid Extractable
- Cyanide
- Mercury
- Heavy metals
- Nitrogen-Phosphorous Pesticides
- Chlorinated Pesticides and Polychlorinated Biphenyls (PCBs)
- Volatile Organic Compounds (VOCs)

A complete priority pollutant analyte list is furnished in *Appendix A*.

Spring Selection Process

Springs that were sampled for the July 2002 priority pollutant screening were selected from the SWFWMD's Coastal Springs Monitoring Network. This network currently consists of 50 springs, from which samples are collected either yearly or quarterly. For the July 2002 event, 1st and 2nd magnitude springs were selected for the priority pollutant screening and designated as *Set A*. The Water Quality Monitoring Program (WQMP) of the Resource Data section sampled *Set A* during the July 2002 sampling of the Coastal Springs Monitoring Network. This set is represented in *Table 1*.

Table 1. Spring selections for Priority Pollutant screening

Priority Pollutant Screening Set A - July 2002					
Site	**Spring Group**	**Magnitude**	**County**	**Latitude**	**Longitude**
Chassahowitzka Main spring	Chassahowitzka	1st	Citrus	284255.44	823434.40
Homosassa #3 spring	Homosassa	1st	Citrus	284757.16	823517.85
Rainbow #1 spring	Rainbow	1st	Marion	290609.19	822615.10
Rainbow #6 spring	Rainbow	1st	Marion	290534.26	822542.33
Sulphur springs	Sulphur	1st	Hillsborough	280114.69	822705.21
Weeki Wachee Main spring	Weeki Wachee	1st	Hernando	283102.00	823423.42
Bubbling spring	Rainbow	2nd	Marion	290604.40	822605.34
Chassahowitzka #1 spring	Chassahowitzka	2nd	Citrus	284258.25	823430.35
Hunters spring	Kings Bay	2nd	Citrus	285339.54	823533.09
Lithia Main spring	Lithia-Buckhorn	2nd	Hillsborough	275159.16	821353.46

As future funding allows, the remaining springs in the Coastal Springs Monitoring Network will be screened for priority pollutants on a "once every two years" frequency. A complete priority pollutant screening of all the springs in the network should then be completed by July 2010. A complete spring selection list is located in *Appendix B* to this report.

Sampling Procedures/Methods

Sampling procedures for the collection of the priority pollutant samples varied according to the depth of the spring vent. Where possible, the sample bottles were filled and capped directly at the spring vent. The extreme depths of some spring vents prohibited this type of "dip-grab" method, so a submersible pump was used to bring spring water directly from the vent to the sample bottles at the surface. *Table 2* indicates the equipment and sample method used for each spring sampled.

Table 2. Sample Methods

STATION	SAMPLE METHOD/EQUIPMENT
RAINBOW #1	DIP GRAB
RAINBOW #6	DIP GRAB
BUBBLING	DIP GRAB
HUNTERS	DIP GRAB
CHASS MAIN	PUMP GRAB / KECK PUMP
CHASS #1	DIP GRAB
LITHIA MAIN	DIP GRAB
SULPHUR	PUMP GRAB / KECK PUMP
WEEKI WACHEE	PUMP GRAB / PERISTALTIC PUMP
HOMOSASSA #3	PUMP GRAB / PERISTALTIC PUMP

The "pump-grab" samples were filled using a Keck submersible pump outfitted with poly-vinyl chloride (PVC) tubing and stainless steel or a Masterflex peristaltic pump also using PVC tubing. The samples were filled with a "concave" meniscus at the top of the sample bottle and gently capped to keep as little air as possible from contaminating the sample. The procedures were most important on the VOC samples. The VOC samples were packed and shipped separately from the other samples.

Detection Limit Terminology

The method detection limit (MDL) is the lowest limit that the instrument analyzing the sample can detect. The practical quantitation limit (PQL) is the lowest concentration that can be *accurately* measured, as opposed to detected. Generally, the PQL is calculated as 3-4 times the MDL for each analyte. The detections above the PQL can be considered "true detections". Those values that are between the MDL and PQL are detections, however the value cannot be considered accurate or quantifiable.

Quality Assurance Samples

For quality assurance, one duplicate and one equipment blank were collected during this sampling event. The quality assurance samples were collected in the same manner that the original sample at the site is collected. The Quality Assurance Project Plan (QAPP) number for SWFWMD sample collection is *870100-G* and the FDEP Lab Analysis QAPP is *900456-9*.

Duplicate Sample

One duplicate sample was collected at Sulphur springs. Two out of the two hundred and two duplicate sample comparisons (**0.1%)** exceeded a relative percent difference (RPD) of 20%. These differences included the analytes of m,p-cresols (50%) and benzene (22.5%).

The FDEP lab stated that the relatively large differences between duplicate samples for substances that are not water-soluble is not unusual. Both m,p-cresols and benzene are fairly insoluble.

Equipment Blank

One equipment blank was collected at Bubbling spring during this sampling event. This sample was collected via dip-grab method. The equipment blank results showed that two out of the two hundred and two parameters (**0.1%)** were at or above MDL values. Detections included: toluene (0.75 ug/L) and m,p-xylene (0.81 ug/L). Both of these detections were between the MDL and the PQL, so are not a concern.

Data Summary and Interpretation

Detections for priority pollutant analytes occurred at Sulphur springs, Weeki Wachee Main spring, Homosassa #3 spring, Hunters spring, and Chassahowitzka Main spring. The detections are summarized in Table 3.

Results show that Sulphur springs showed positive detections for nickel, benzene, manganese, m,p-cresols and toluene. Detections for manganese, benzene, and toluene may suggest the presence of gasoline in storm-water runoff that infiltrates into the Sulphur Spring's recharge area. The spring has been known to have pollution problems associated with storm-water runoff. These detections confirm the problem.

Homosassa #3 spring showed positive detections for manganese and acetophenone.

Chassahowitzka Main spring showed a positive detection for manganese.

Hunters spring showed a positive detection for chloroform.

Weeki Wachee Main spring showed positive detections for toluene and acetophenone.

Manganese detections may show the presence of pesticides and/or gasoline additives. However, it does occur naturally in limestone and dolomite where manganese substitutes for calcium in these rock types.

Table 3. Priority pollutant screening detections for July 2002 sampling event

Station	Parameter	Value Between MDL and PQL (ug/L)	Value Above MDL and PQL (true detections) (ug/L)	Laboratory MDL (ug/L)*	Guidance Conc. Level (ug/L)
Chassahowitzka Main	Manganese		**4**	0.5 - 1.1	50
Homosassa #3	Manganese	1.1		0.5 - 1.1	50
Homosassa #3	Acetophenone		**4.7**	0.95 - 1.1	700
Hunters	Chloroform	0.3		0.2	6
Sulphur	Nickel	2.7		1.5 - 2.0	100
Sulphur	Benzene	0.63		0.5	1
Sulphur	Manganese		**41.3**	0.5 - 1.1	50
Sulphur	m,p-Cresols		**250**	1.9 - 2.2	350
Sulphur	Toluene		**13**	0.5	1000 / 40**
Weeki Wachee	Acetophenone	2.2		0.95 - 1.1	700

Source: Groundwater Guidance Concentrations, Florida Dept. of Environmental Protection

* Laboratory method detection limits vary with each sample run

** Toluene has a primary standard of 1000 ug/L and a secondary standard of 40 ug/L

A sampling of priority pollutants at springs throughout the SWFWMD has never been completed. Because of this, there is no historical data of this kind to compare to.

Appendix C lists the descriptions and health concerns for each of the detected analytes.

Conclusions

There were detections for analytes considered priority pollutants at several SWFWMD springs. However, none of the detections violated the ground-water guidance concentrations set by the FDEP. Also, there were only five true detections (values above MDL and PQL) throughout the sampling event.

Sulphur springs contained the most detections for any spring sampled during this event. The most probable culprit of this contamination seems to be storm-water runoff infiltration of the Upper Floridan aquifer system throughout the Sulphur spring's recharge area.

Future Sampling Events

The next priority pollutant sampling event is scheduled for July 2004. During this sampling event, *Set B* will be sampled.

APPENDIX A

Priority Pollutant Parameter List

EPA 614, Organonitrogen and phosphorus pesticides
Alachlor
Ametryn
Atrazine
Azinphos Methyl
Bromacil
Butylate
Chlorpyrifos Ethyl
Chlorpyrifos Methyl
Diazinon
Ethion
Ethoprop
Fenamiphos
Fonofos
Hexazinone
Malathion
Metalaxyl
Metolachlor
Metribuzin
Mevinphos
Naled
Norflurazon
Parathion Ethyl
Parathion Methyl
Phorate
Prometryn
Simazine

EPA 608, Organochlorine pesticides and PCB's
Aldrin
Alpha-BHC
Beta-BHC
Delta-BHC
Gamma-BHC
Chlordane
DDD-p,p'
DDE-p,p'
DDT-p,p'
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Endrin
Endrin Aldehyde
Heptachlor
Heptachlor Epoxide
Methoxychlor
Toxaphene
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260

EPA 2207/6010B, Metals
Aluminum
Arsenic
Antimony
Beryllium
Cadmium
Chromium
Copper
Lead
Manganese
Nickel
Selenium
Silver
Thallium
Zinc

EPA 624/8260, Volatile Organic Pollutants
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,3-Dichlorobenzene
1,4-Dichlorobenzene
2-Chloroethylvinyl ether
4-Aminobiphenyl
5-Nitro-o-toluidine
Benzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
cis-1,3-Dichloropropene
Dibromochloromethane
Ethylbenzene
m,p-Xylene
Methylene chloride
o-Xylene
Pentachloroethane
Pentachloronitrobenzene
Phenacetin
Tetrachloroethene
Toluene
trans-1,2-Dichloroethene
trans-1,3-Dichloropropene
Trichloroethene
Trichlorofluoromethane
Vinyl chloride

EPA 335.4, Cyanide
Cyanide

EPA 245.1, Mercury
Mercury

EPA 8270, Semi-organic pollutants
1,2,4,5-Tetrachlorobenzene
1,2,4-Trichlorobenzene
1,2-Dichlorobenzene
1,3,5-Trinitrobenzene
1,3-Dichlorobenzene
1,3-Dinitrobenzene
1,4-Dichlorobenzene
1,4-Naphthoquinone
1-Naphthylamine
2,3,4,6-Tetrachlorophenol
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dichlorophenol
2,6-Dinitrotoluene
2-Acetylaminofluorene
2-Chloronaphthalene
2-Chlorophenol
2-Methyl-4,6-dinitrophenol
2-Methylnaphthalene
2-Naphthylamine
2-Nitroaniline
2-Nitrophenol
2-Picoline
3,3'-Dichlorobenzidine
3,3'-Dimethylbenzidine
3-Methylcholanthrene
3-Nitroaniline
4,4'-DDD
4,4'-DDE
4,4'-DDT
4-Aminobiphenyl
4-Bromophenyl phenyl ether
4-Chloro-3-methylphenol
4-Chloroaniline
4-Chlorophenyl phenyl ether
4-Nitroaniline
4-Nitrophenol
7,12-Dimethylbenz(a)anthracene
Acenaphthene
Acenaphthylene
Acetophenone
Aldrin
alpha-BHC
Aniline
Anthracene
Azobenzene/1,2-Diphenylhydrazine
Benzidine
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Benzyl alcohol
beta-BHC
Bis(2-chloroethoxy)methane
Bis(2-chloroethyl)ether
Bis(2-chloroisopropyl)ether
Bis(2-ethylhexyl)phthalate
Butyl benzyl phthalate
Chrysene
delta-BHC
Dibenzo(a,h)anthracene
Dibenzofuran
Dieldrin
Diethyl phthalate
Dimethyl phthalate
Dimethylaminoazobenzene
Di-n-butyl phthalate
Di-n-octyl phthalate
Dinoseb
Diphenylamine
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin aldehyde
Ethyl methanesulfonate
Fluoranthene
Fluorene
gamma-BHC
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Hexachloropropene
Indeno(1,2,3-cd)pyrene
Isophorone
Isosafrole
m,p-Cresols
Methapyrilene
Methyl methanesulfonate
Naphthalene
Nitrobenzene
Nitroquinoline-1-oxide
N-Nitrosodiethylamine
N-Nitrosodimethylamine
N-Nitrosodi-n-butylamine
N-Nitrosodi-n-propylamine
N-Nitrosodiphenylamine
N-Nitrosomethylethylamine
N-Nitrosomorpholine

N-Nitrosopiperidine
N-Nitrosopyrrolidine
o-Cresol
o-Toluidine
Pentachlorobenzene
Pentachloroethane
Pentachloronitrobenzene
Pentachlorophenol
Phenacetin
Phenanthrene
Phenol
Pyrene
Pyridine
Safrole

APPENDIX B

Spring Selections for Priority Pollutant Screening

Priority Pollutant Screening Set A - July 2002					
Site	**Spring Group**	**Magnitude**	**County**	**Latitude**	**Longitude**
Chassahowitzka Main Spring	Chassahowtizka	1st	Citrus	284255.44	823434.4
Homosassa #3 Spring	Homosassa	1st	Citrus	284757.16	823517.85
Rainbow #1 Spring	Rainbow	1st	Marion	290609.19	822615.1
Rainbow #6 Spring	Rainbow	1st	Marion	290534.26	822542.33
Sulphur Springs	Sulphur	1st	Hillsborough	280114.69	822705.21
Weeki Wachee Main Spring	Weeki Wachee	1st	Hernando	283102	823423.42
Bubbling Spring	Rainbow	2nd	Marion	290604.4	822605.34
Chassahowitzka #1 Spring	Chassahowtizka	2nd	Citrus	284258.25	823430.35
Hunters Spring	Kings Bay	2nd	Citrus	285339.54	823533.09
Lithia Main Spring	Lithia-Buckhorn	2nd	Hillsborough	275159.16	821353.46

Priority Pollutant Screening Set B - July 2004					
Site	**Spring Group**	**Magnitude**	**County**	**Latitude**	**Longitude**
Homosassa #1 Spring	Homosassa	1st	Citrus	284757.17	823517.86
Homosassa #2 Spring	Homosassa	1st	Citrus	284757.15	823517.81
Rainbow #4 Spring	Rainbow	1st	Marion	290606.73	822613.77
Buckhorn Main Spring	Lithia-Buckhorn	2nd	Hillsborough	275321.73	821809.77
Citrus-Blue Spring	Panasoffkee	2nd	Citrus	285809.76	821852.76
Fenney Spring	Panasoffkee	2nd	Sumter	284741.9	820217.12
Gum Springs #1	Gum Slough	2nd	Sumter	285733.49	821350.83
Gum Springs Main	Gum Slough	2nd	Sumter	285731.39	821353.48
Shady Brook Head Spring	Panasoffkee	2nd	Sumter	284708.96	820244.13
Tarpon Hole Spring	Kings Bay	2nd	Citrus	285254.42	823541.01

Priority Pollutant Screening Set C - July 2006					
Site	**Spring Group**	**Magnitude**	**County**	**Latitude**	**Longitude**
Crab Spring	Chassahowitzka	2nd	Citrus	284302.5	823433.6
Jenkins Creek	Weeki Wachee	2nd	Hernando	283119.31	823802.64
Ruth Spring	Chassahowitzka	2nd	Citrus	284355.18	823543.87
Salt Spring	Weeki Wachee	2nd	Hernando	283246.62	823708.39
Betee Jay Spring	Storch	3rd	Hernando	284125.39	823529.41
Blue Grotto Spring	Gulf Hammock	3rd	Marion	282316.17	822910.78
Crystal Beach Spring	Offshore	3rd	Pinellas	280503.51	824705.13
Health Spring	Pinellas	3rd	Pinellas	280622.93	824620.33
Hidden River #2 Spring	Hidden River	3rd	Citrus	284607.01	823503.63
Hidden River Head Spring	Hidden River	3rd	Citrus	284607.36	823459.69

Priority Pollutant Screening Set D - July 2008					
Site	**Spring Group**	**Magnitude**	**County**	**Latitude**	**Longitude**
Baird Spring	Chassahowitzka	3rd	Citrus	284226.79	823441.03
Black Spring	Kings Bay	3rd	Citrus	285238.63	823557.2
Boat Spring	Aripeka	3rd	Hernando	282611.72	823923.06
Bobhill Spring	Aripeka	3rd	Hernando	282604.96	823827.98
Catfish Spring	Kings Bay	3rd	Citrus	285353.44	823555.2
Idiots Delight	Kings Bay	3rd	Citrus	285316.67	823521.93
Wilson Head Spring	Panasoffkee	3rd	Marion	285847.23	821916.14
Magnolia Spring	Aripeka	4th	Hernando	282602.11	823908.97
Pumphouse Spring	Homosassa	4th	Citrus	284746.96	823517.65
Trotter Main Spring	Homosassa	5th	Citrus	284747.3	823510.97

Priority Pollutant Screening Set E - July 2010					
Site	**Spring Group**	**Magnitude**	**County**	**Latitude**	**Longitude**
Boyette Spring	Lithia-Buckhorn	5th	Hillsborough	275113.2	821626.52
Blue Run	Storch	3rd	Hernando	284112.5	823605.17
Rainbow Bridge Seep North Spring	Rainbow	4th	Marion	290606.99	822615.98
Rainbow Swamp #3 Spring	Rainbow	4th	Marion	290534.74	822515.27
Big King Spring	Gulf Hammock	3rd	Levy	290659.88	823832.7
Little King Spring	Gulf Hammock	3rd	Levy	290639.12	823846.32
Gum Springs #2	Gum Slough	4th	Sumter	285713.84	821412.69
Beltons Millpond Main Spring	Panasoffkee	3rd	Sumter	284524.39	820405.36
Canal 485A Spring 1B	Panasoffkee	5th	Sumter	284610.6	820704.8
Halls River Head Spring	Homosassa	3rd	Citrus	284936.51	823449.18

APPENDIX C

Description, sources, and health concerns of detected priority pollutants

Pollutant	Description	Sources/Uses	Health Concerns
Acetophenone**	Acetophenone is a clear to light yellow liquid and has poor solubility in water.	Used as a component in perfumes and as a catalyst for the manufacture of drugs, resins, alcohols, acetate, aldehydes, and tear gas. Used as a drug to induce sleep.	Acute exposure may produce irritation and transient corneal injury, light sensitivity, hypnotic or sedative effects, hematological effects, weakened pulse, congestion of lungs, kidneys and liver.
Benzene*	Benzene is a colorless liquid with a sweet odor. It evaporates into air quickly and dissolves slightly in water.	Used to make plastics, resins, nylon, synthetic fibers, rubbers, lubricants, dyes, detergents, drugs and pesticides. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke.	High levels of benzene exposure can result in drowsiness, dizziness, rapid heartbeat, headaches, tremors, confusion, unconsiousness or death.
Chloroform*	Chloroform is a colorless liquid with a pleasant, non-irritating odor and a slightly sweet taste. It is volatile and readily evaporates when in contact with air. It does not adsorb to soils and travels well through soil to groundwater.	Chloroform is used in industry and laboratory settings as a solvent for adhesives, pesticides, fats, oils and rubbers.	Acute inhalation exposure can affect the central nervous system, cardiovascular system, stomach, liver and kidneys.
Cresols*	Cresols are widely occuring natural and manufactured group of chemicals. In their pure form, they are colorless solids, and may be liquids if they are mixtures. Smell like medicine.	They are used to dissolve other chemicals, as disinfectants and deodorizers, and to make chemicals that kill insect pests. Found in many foods, tobacco smoke, crude oil, and coal tar.	Low levels are not harmful. High levels can cause irritation and burning skin, eyes, mouth, and throuat, abdominal pain and vomiting, heart damage, anemia, liver and kidney damage, facial paraylsis, coma, and death.
Manganese*	Manganese is a naturally occuring metal that is found in many types of rocks. It can also be combined with carbon to make organic manganese compounds.	Manganese compounds includes pesticides, and fuel additives in some gasolines.	High level, long term exposure can develop mental and emotional disturbances, respiratory problems and sexual dysfunction.
Nickel*	Nickel is a naturally occuring metal that incredibly abundant and is usually associated with oxides and sulfides. It has no taste or odor.	Nickel is found in all soils naturally. Other sources include nickel plating, coloring ceramics, batteries, coins,and jewelry.	The most common adverse reactions to nickel includes allergic reaction that includes a skin rash. Other affects include respiratory, stomach and kidney distress.
Toluene*	Toluene is a clear liquid with a distinctive smell. Toluene occurs naturally in crude oil and in the tolu tree.	It is produced in the process of making gasoline and other fuels from crude oil. Also used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber.	Toluene may affect the central nervous system. Low to moderate levels can cause tiredness, confusion, weakness, memory loss, nausea, loss of apetite and hearing and vision loss.

***Source: Center for Disease Control - Agency for Toxic Substances and Disease Registration, www.atsdr.cdc.gov**

****Source: Environmental Protection Agency - Air Toxics Website, www.epa.gov/ttn/atw**