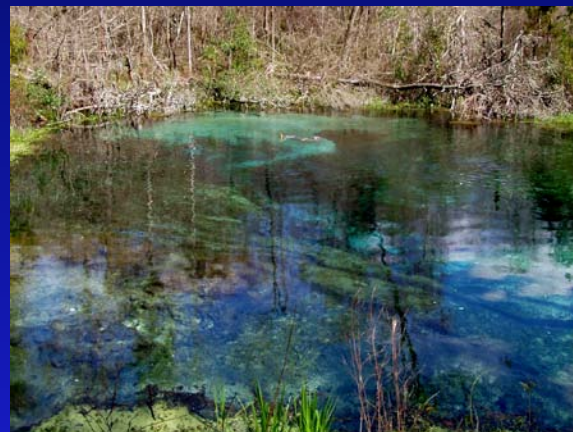


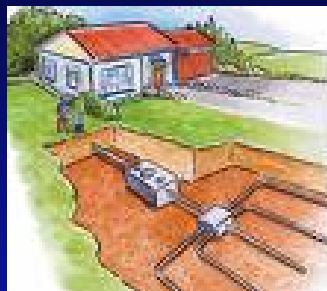
Chemicals from Pharmaceuticals in Florida Springs



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Chemicals we use or consume every day in small amounts



can be concentrated in the waste stream and enter the environment in measurable amounts.

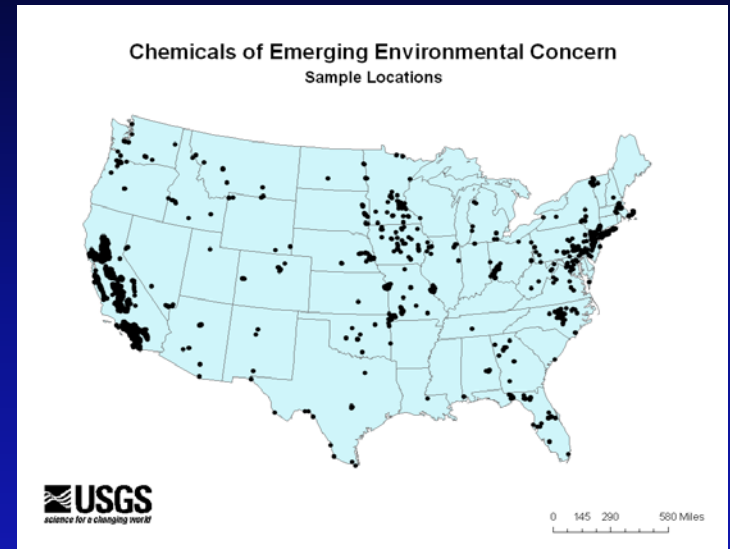
Occurrence of Pharmaceuticals and other organic wastewater compounds – National Reconnaissance Studies

Streams (1999-2000)

Ground Water (2000)

Sources of Drinking Water (2001)

Streambed Sediment (2002)



ES&T; March 15, 2002
v. 36, no. 6, p. 1202-1211

>1500 Sites
>400 Streams
>1,000 Wells
>75 WWTPs

64 Wastewater Indicator Compounds Analyzed

(USGS National Water Quality Laboratory)

Fragrances and Flavorants

AHTN
 HHCB
 3-Methyl-1H-indole (skatol)
 Acetophenone
 Camphor
 Isoborneol
 Isoquinoline
 Menthol

Flame Retardants

Tris(2-chloroethyl) phosphate
 Tris(dichlorisopropyl) phosphate
 Tributyl phosphate

Antioxidants

5-Methyl-1H-benzotriazole
 3-*tert*-butyl-4-hydroxyanisole (BHA)

Fuel-Related Compounds

1-Methylnaphthalene
 2,6-Dimethylnaphthalene
 2-Methylnaphthalene
 Isopropylbenzene (cumene)

Detergent Metabolites

ρ -Cumylphenol
 ρ -*n*-Octylphenol
 ρ -Nonylphenol diethoxylate (NPEO2)
 ρ -Octylphenol diethoxylate (OPEO2)
 ρ -Octylphenol monoethoxylate (OPEO1)
 ρ -*tert*-octylphenol
 ρ -Nonylphenol (total, NP)

Plasticizers

Bisphenol A
 Tris(2-butoxyethyl) phosphate
 Triphenyl phosphate

Disinfectants

Triclosan

Phenol

Solvents and Preservatives

Isophorone
Tetrachloroethylene
 ρ -cresol
Pentachlorophenol

Pesticides

Bromacil
Carbaryl
 Carbazole
Chlorpyrifos
 Diazinon
 d-Dichlorvos
 d-Limonene
 Indole
 Metalaxyl
Metolachlor
 N,N-diethyl-meta-toluamide (DEET)
Prometon

Plant and Animal Steroids

3- β -coprostanol
 β -sitosterol
 β -stigmastanol
 Cholesterol

PAHs

Anthracene
Benzo[a]pyrene
 Fluoranthene
Naphthalene
 Phenanthrene
 Pyrene

Others

Antraquinone (manufacturing)
1,4-dichlorobenzene (deodorizer)
 Benzophenone (fixative)
Bromoform (disinfection byproduct)
 Caffeine (stimulant)
 Cotinine (nicotine metabolite)
 Methyl salicylate (liniment)
 Triethyl citrate (ethyl citrate) (cosmetics)

Method reporting levels are 0.5 ppb (ug/L) for most compounds.



Human Health Pharmaceuticals Analyzed

(USGS National Water Quality Laboratory)

Over-the-counter pharmaceuticals



<i>Compound</i>	<i>Common Name(s)</i>	<i>Use</i>	Reporting level ppb (µg/L)*
Acetaminophen	<i>Tylenol</i>	<i>Analgesic</i>	0.12
Caffeine	<i>No-Doz</i>	<i>Stimulant</i>	0.06
1,7-dimethyl-xanthine		<i>Caffeine metabolite</i>	0.10
Codeine	<i>Robitussin AC</i>	<i>Opioid narcotic; cough suppressor</i>	0.046
Cotinine		<i>Nicotine metabolite</i>	0.038
Diphenhydramine	<i>Benadryl; Chlortrimeton</i>	<i>Antihistamine</i>	0.036

*1 ppb = 1 second in 32 years; or 1 penny in \$10,000,000



Human Health Pharmaceuticals Analyzed

(USGS National Water Quality Laboratory)

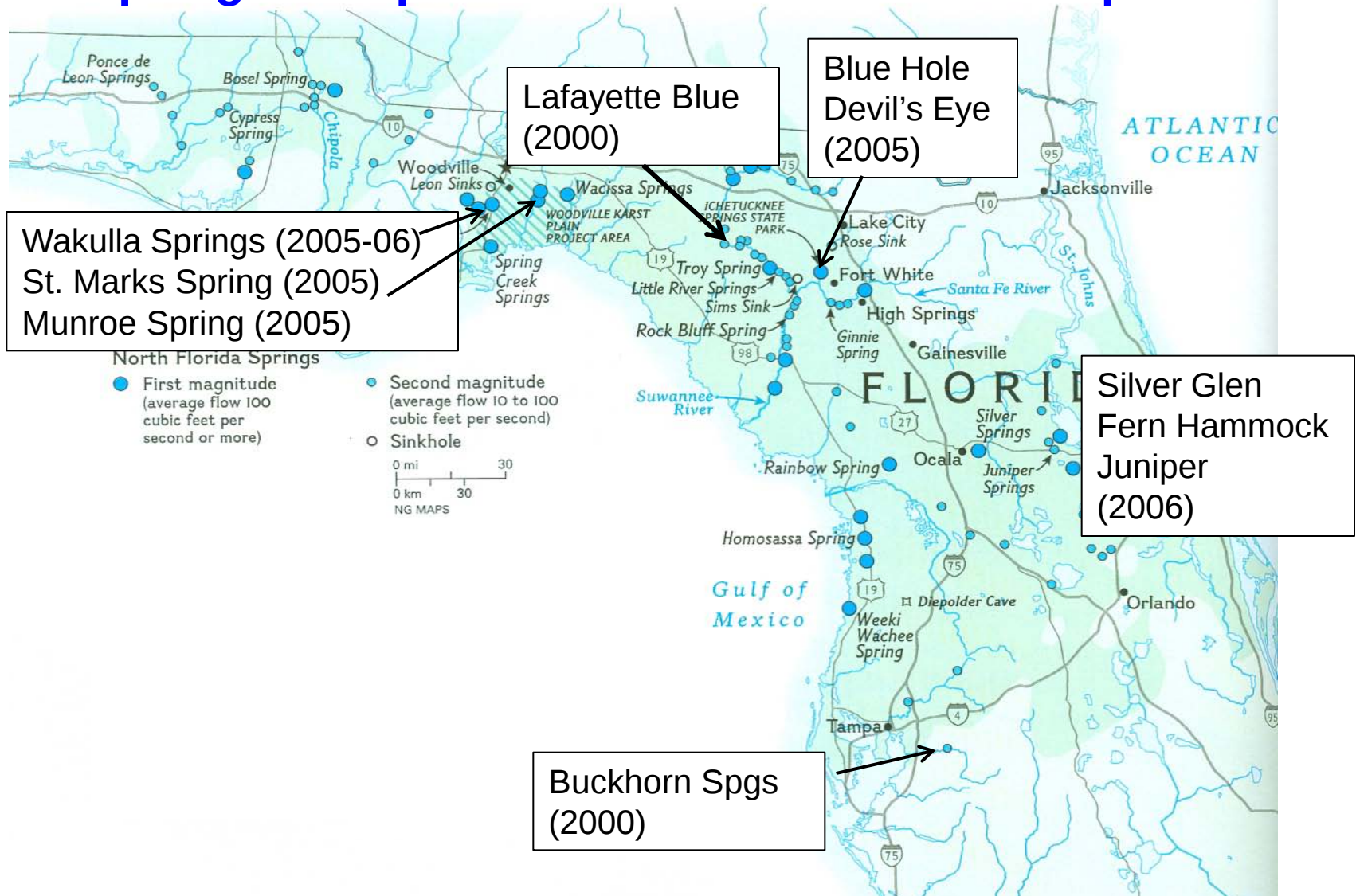


Prescription drugs

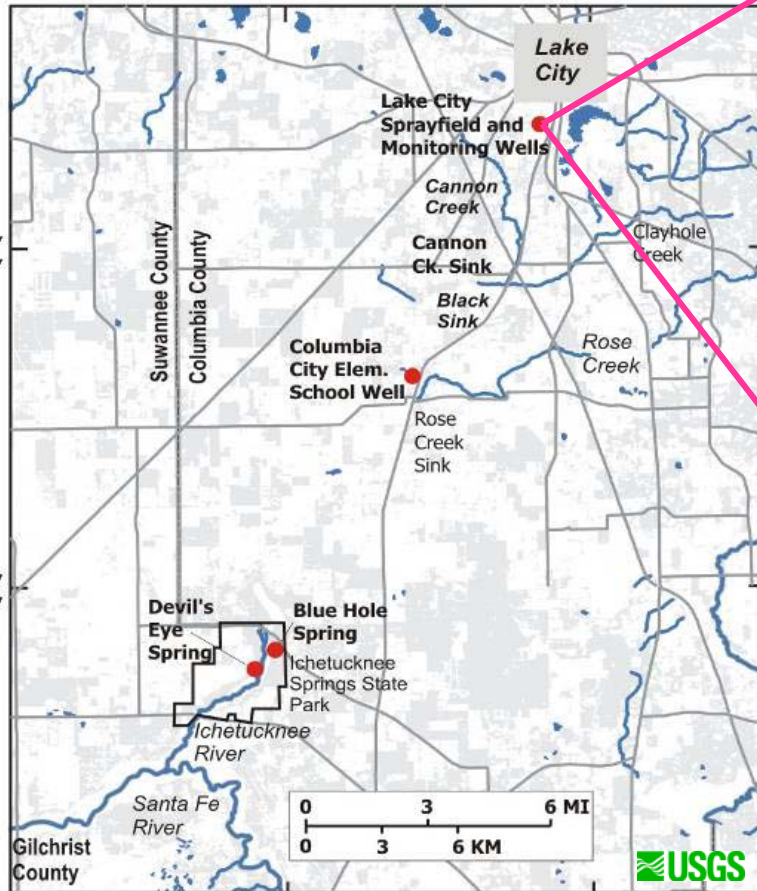


<i>Compound</i>	<i>Common Name(s)</i>	<i>Use</i>	Reporting level ppb
Carbamazapine *	Tegretol, Atretol	Antiepileptic; anti-depressant	0.06
Dehydronifedipine	Procardia	Antiarrhythmic	0.08
Diltiazem	Cardizem CD	Antianginal, antiarrhythmic, and antihypertensive	0.06
Salbutamol	Albuterol, Aerosol	Bronchodilator (asthma)	0.08
Sulfamethoxazole *	Gantanol	Antibiotic	0.16
Thiabendazole	Mintezol	Anthelmintic	0.06
Trimethoprim	Proloprim; Trimplex	Antibiotic	0.034
Warfarin	Coumadin Tabs	Anticoagulant	0.08

10 Springs Sampled for Pharmaceutical Compounds



Pharmaceutical compounds in water from Lake City STP reservoir, wells, and springs



Site	Compound	E	Detected
STP Effluent Res.			
stimulant	caffeine	0.009	0.15
cough suppressant	codeine	0.02	0.034
angina metabolite	dehydronifedepine	0.01	0.015
nicotine metabolite	cotinine		0.042; 0.037
antiarrhythmic	diltiazem	0.015	
antibiotic	sulfamethoxazole		0.32; 0.53
antibiotic	trimethoprim		0.04; 0.035
caffeine metabolite	1,7 dimethyloxanthine		0.11
anticonvulsant	carbamazepine		0.1; 0.1
antihistamine	diphenhydramine		0.07; 0.09
broncodilator	salbutamol		0.02
acid reducer	cimetidine		0.05

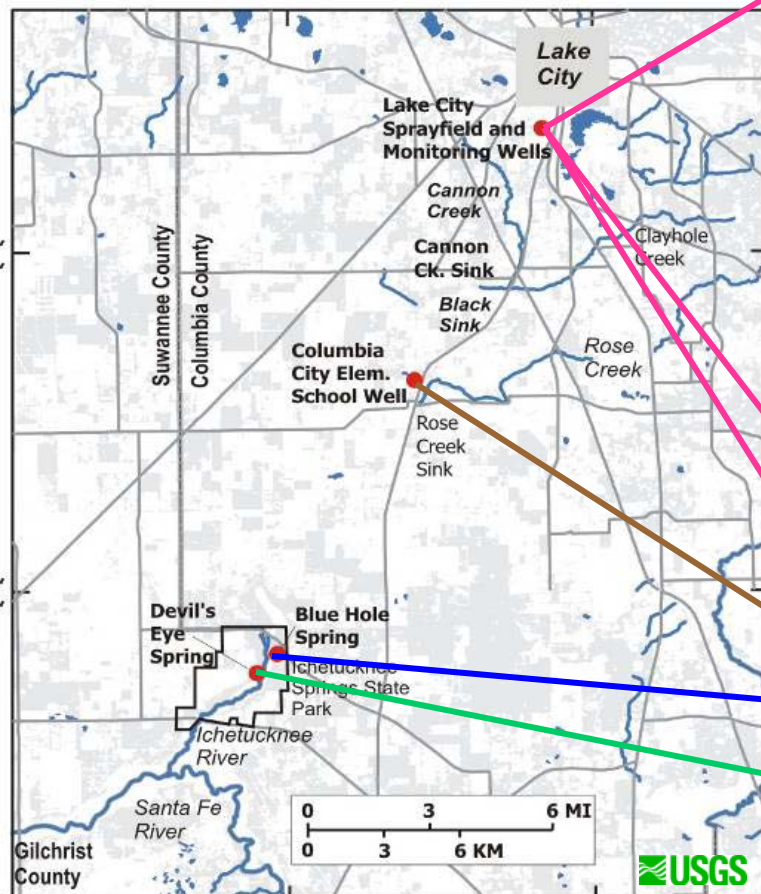
E, estimated value

May 2005

October 2005

Both

Pharmaceutical compounds in water from Lake City STP reservoir, wells, and springs



		Concentration, ug/L (ppb)	
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antihistamine	diphenhydramine		0.07; 0.09
broncodilator	salbutamol		0.02
acid reducer	cimetidine		0.05
LCS-MBW			
anticonvulsant	carbamazepine		0.023; 0.033
MW-7			
antibiotic	sulfamethoxazole	0.013	
CCESW	NONE		
Blue Hole Spring	NONE		
Devil's Eye Spring			
anticonvulsant	carbamazepine	0.0026	
antihistamine	diphenhydramine	0.004	

E, estimated value

May 2005

October 2005

Both

Map showing connections Between residence and Several locations in Ichetucknee Springs State Park

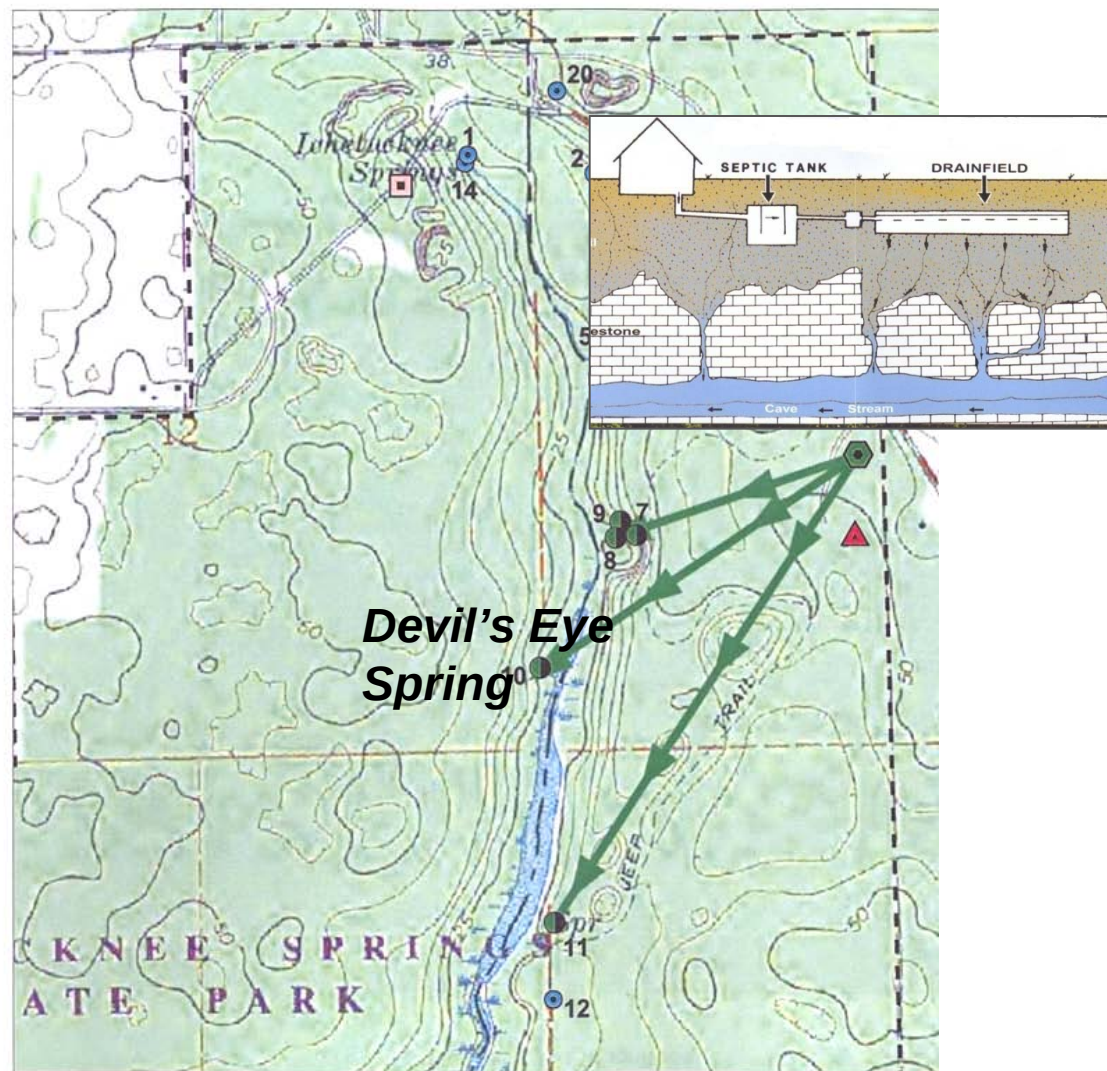
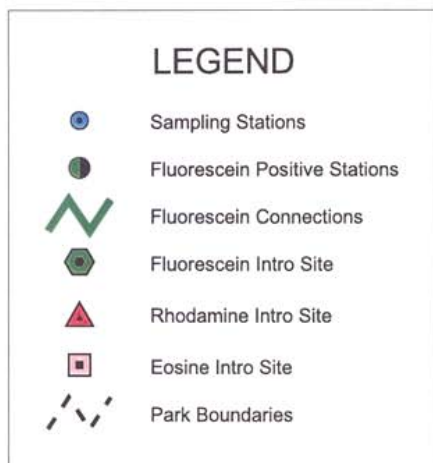


Figure 6.
Sampling Stations Results Map.

P. L. Butt, 2005



Ensuring a representative measurement

- * Consistent field protocols
- * Field Quality Assurance
- * Laboratory QA
- * Multiple-lab QA datasets
- * Interlab comparison & coordination



Ongoing USGS national studies— more emphasis on Linking Environmental Contamination and Ecosystem Effects



Questions ??



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