PESTICIDE SURFACE WATER AND SEDIMENT QUALITY REPORT

APRIL 2011 SAMPLING EVENT

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Pesticide Monitoring Program Report
April 2011 Sampling Event

Summary

As part of the South Florida Water Management District's (SFWMD) quarterly ambient monitoring program, unfiltered water and sediment samples were collected April 25 to April 28, 2011, and analyzed for over 70 pesticides and/or products of their degradation.

The herbicides ametryn, atrazine, hexazinone, norflurazon, and simazine, along with the insecticide/degradates atrazine desethyl, were detected in one or more of these surface water samples. No harmful impacts are expected from the detected pesticides.

The insecticides and degradates DDD, DDE, alpha endosulfan, beta endosulfan, and endosulfan sulfate were found in the sediment at several locations. One DDE compound sediment concentration was of a magnitude considered to have a harmful effect to freshwater sediment-dwelling organisms. No harmful impacts are expected from the other detected pesticides.

The compounds and concentrations found are typical of those expected from an area of intensive historical and contemporary agricultural activity.

Background and Methods

The SFWMD pesticide monitoring network includes stations designated in the Everglades Settlement Agreement, the Lake Okeechobee Protection Act Permit, and the non-Everglades Construction Project (non-ECP) permit. The canals and marshes depicted in Figure 1 are protected as Florida Administrative Code (F.A.C.) 62-302 Class III (fishable and swimmable) waters, while Lake Okeechobee and a segment of the Caloosahatchee River are protected as a Class I drinking water supply. Water Conservation Area 1 (WCA-1) and the Everglades National Park are also designated as Outstanding Florida Waters, to which anti-degradation standards apply. Surface water and sediment are sampled quarterly and semiannually, respectively, upstream at each structure identified in the permit or agreement.

Seventy-three pesticides and degradation products were analyzed in samples from 26 of the network 27 sites (Figure 1). The analytes, their respective method detection limits (MDLs), and practical quantitation limits (PQLs) are listed in Table 1. All the analytical work is performed by the Florida Department of Environmental Protection (FDEP) Central Laboratory in Tallahassee, Florida. Analytical method details can be found at the following location: http://www.dep.state.fl.us/labs/cgi-bin/sop/chemsop.asp.

To evaluate the potential impacts on aquatic life, the observed concentration is compared to the appropriate criterion outlined in F.A.C. 62-302.530. If a pesticide compound is not specifically listed, acute and chronic toxicity criterion are calculated as one-third and one-twentieth, respectively, of the amount lethal to 50% of the test organisms in 96 hours, using the lowest technical grade effective concentration 50 (EC_{50}) or lethal concentration 50 (LC_{50}) reported in the summarized literature for the species significant to the indigenous aquatic community (F.A.C. 62-302.200). Each pesticide's description and possible uses and sites of application described herein are taken from Hartley and Kidd (1987). Sediment concentrations are compared to freshwater sediment quality assessment guidelines (MacDonald Environmental Sciences, Ltd., and United States Geological Survey, 2003). A value below the threshold effect concentration (TEC) should not have a harmful effect on sediment-dwelling organisms. Values above the probable effect concentration (PEC) demonstrate that harmful effects to sediment-dwelling organisms are likely to be frequently or always observed. This summary covers surface water and sediment samples collected from April 25 to April 28, 2011.

Results

At least one pesticide was detected in surface water at 17 of the 26 sites and in sediment at 10 of the 23 sites. Modifications to the non-ECP permit changed the requirement for sampling at S142 to only during discharge or flow events. For this sampling event, no sample was obtained due to the lack of discharge at the time of sample collection. A reevaluation of the monitoring area outlined in the Everglades Settlement Agreement determined that seven sites (GORDYRD, S80, S99, S78, CR33.5T, S79, and S235) were not within the designated area, therefore without any other mandate, will no longer be sampled. Sediment samples are not collected at S333, S356-334, and TAMBR105, due to no requirement in the respective mandate. The concentrations of the pesticides detected at each of the sites are summarized for the surface water and sediment in Tables 2 and 3, respectively. All of these compounds have previously been detected in this monitoring program.

The sediment DDE concentration at S2 was of a magnitude considered to represent detrimental effects to sediment-dwelling organisms in freshwater sediments. All other detected concentrations in the surface water and sediment were below any effect level.

The above findings must be considered with the caveat that pesticide concentrations in surface water and sediment may vary significantly in relation to the timing and magnitude of pesticide application, rainfall events, pumping and other factors, and that this was only one sampling event. The possible long-term or chronic toxicity impacts are also reported based on the single sampling event and do not take into account previous monitoring data.

Usage and Water Quality Impacts

<u>Ametryn</u>: Ametryn is a selective terrestrial herbicide registered for use on sugarcane, bananas, pineapple, citrus, corn, and non-crop areas. Most algal effects occur at concentrations greater than (>) 10 μg/L (Verschueren, 1983). Environmental fate and toxicity data in Tables 4 and 5 indicate that ametryn (1) is lost from soil relatively easily by leaching, surface adsorption, and in surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data include a 96-hour LC_{50} of 14.1 milligrams per liter (mg/L) for goldfish (Hartley and Kidd, 1987). The ametryn surface water concentrations found in this sampling event ranged from 0.015 to 0.037 μg/L. Using these criteria, these observed surface water concentrations should not have an acute, detrimental impact on fish or aquatic invertebrates. Ametryn was not detected in the sediment.

<u>Atrazine</u>: Atrazine is a selective systemic herbicide registered for use on pineapple, sugarcane, corn, rangelands, ornamental turf and lawn grasses, and non-crop areas. Environmental fate and

toxicity data in Tables 4 and 5 indicate that atrazine (1) is easily lost from soil by leaching and in surface solution, with moderate loss from surface adsorption; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data include a 96-hour LC_{50} of 76 mg/L for carp, 16 mg/L for perch, and 4.3 mg/L for guppies (Hartley and Kidd, 1987). Also, in a flow-through bioassay, the maximum acceptable toxicant concentration (MATC) of atrazine was 90 and 210 μg/L for bluegill and fathead minnow, respectively (Verschueren, 1983). The draft ambient aquatic life water quality criterion identifies a one-hour average concentration that does not exceed 1,500 μg/L more than once every three years on the average (United States Environmental Protection Agency [U.S. EPA], 2003). The atrazine surface water concentrations found in this sampling event at 17 of the 26 sampling locations, ranged from 0.021 to 2.2 μg/L. Using these criteria, these observed surface water concentrations should not have an acute or chronic detrimental impact on fish or invertebrates. Atrazine was not detected in the sediment.

Atrazine desethyl (DEA) and atrazine desisopropyl (DIA) are biotic degradation products of atrazine. These degradation products are both persistent and mobile in water; however, DEA is more stable and the dominant initial metabolite. Since DEA and DIA are structurally and toxicologically similar to atrazine, the concentrations of total atrazine residue (atrazine + DEA + DIA) may also be a significant consideration in the surface water environment. The DEA to atrazine ratio (DAR), on a molar basis, has been suggested as an indicator of nonpoint-source pollution of groundwater (Adams and Thurman, 1991) and as a tracer of groundwater discharge into rivers (Thurman et al., 1992). Goolsby et al. (1997) determined that low DAR values, median <0.1, occur in streams during runoff shortly after application of atrazine. Higher DAR values, median about 0.4, occur later in the year after considerable degradation of atrazine to DEA has occurred in the soil. The low median DAR ratio (e.g. 0.1 to 0.2) at the locations where both atrazine and DEA were detected, suggests minimum degradation of atrazine (Table 6). However, these general guidelines were developed based on observations in Midwest watersheds in northern temperate climates with different soil and water management regimes as well as higher atrazine water concentrations. Applications to the South Florida environment should be made with caution.

<u>DDE</u>: DDE is an abbreviation of **d**ichloro**d**iphenyldichloro**e**thylene [2, 2-bis (4-chlorophenyl)-1, 1-dichloroethene]. DDE is an environmental dehydrochlorination product of DDT (**d**ichloro**d**iphenyl**t**richloroethane), a popular insecticide for which the U.S. EPA cancelled all uses in 1973. The large volume of DDT used, the persistence of DDT, DDE and another metabolite, DDD (**d**ichloro**d**iphenyl**d**ichloroethane), and the high K_{oc} of these compounds account for the frequent detections in sediments. The large hydrophobicity of these compounds also results in a significant bioconcentration factor (Table 4). In sufficient quantities, these residues have reproductive effects in wildlife and carcinogenic effects in many mammals.

The TEC is 3.2 μg/Kg and the PEC is 31 μg/Kg for DDE in freshwater sediments. The concentration of DDE detected at S2 exceeded the PEC and frequently or always have the possibility for impacting sediment-dwelling organisms. DDE was not detected in the surface water.

Endosulfan: Endosulfan is a non-systemic insecticide and acaricide registered for use on many crops, including beans, tomatoes, corn, cabbage, citrus, and ornamental plants. Technical endosulfan is a mixture of the two stereoisomeric forms, alpha (α) and beta (β). Endosulfan is highly toxic to mammals, with an acute oral LD_{50} for rats of 70 mg/Kg (Table 4). The Soil Conservation Service (SCS) rates endosulfan with an extra small potential for loss due to leaching, a large potential for loss due to surface adsorption and a moderate potential for loss in surface solution (Table 4). Beta endosulfan's water solubility and Henry's law constant (1.91 x 10^{-5} atm – m^3/mole) (Lyman, et al., 1990) indicate volatilization may be significant in shallow waters. The bioconcentration factors indicate a low to moderate degree of accumulation in aquatic organisms (Table 4). Alpha and beta endosulfan were detected in the sediment at S178 in the South Miami-Dade County farming area (Table 2). However, a sediment quality assessment guideline has not been developed. Endosulfan was not detected in the surface water.

Endosulfan sulfate: Endosulfan sulfate is an oxidation metabolite of the insecticide endosulfan. The water solubility and Henry's law constant (9.63 x 10^{-8} atm – m^3/mole) (Lyman, et al., 1990) indicate that endosulfan sulfate is less volatile than water and concentrations will increase as water evaporates (Table 4). Endosulfan sulfate has a relatively high degree of accumulation in aquatic organisms (Table 4). Endosulfan sulfate was detected in the sediment at S178. However, no sediment quality assessment guideline has been developed for endosulfan sulfate. Endosulfan sulfate was not detected in the surface water.

Hexazinone: Hexazinone is a non-selective contact herbicide that inhibits photosynthesis. Registered uses include sugarcane, pineapple, and non-crop areas. Environmental fate and toxicity data in Tables 4 and 5 indicate that hexazinone (1) is easily lost from soil by leaching, with moderate loss from surface adsorption or surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Hexazinone is practically non-toxic to freshwater invertebrates with an EC_{50} of 145 mg/L for *Daphnia magna* (U.S. EPA, 1988). The highest surface water concentration detected in this sampling event at S191 (0.25 μg/L) (Table 2) should not have an acute impact on fish or aquatic invertebrates.

Norflurazon: Norflurazon is a selective herbicide registered for use on many crops including citrus. Environmental fate and toxicity data in Tables 4 and 5 indicate that norflurazon (1) is easily lost from soil surface solution and a moderate potential for loss due to leaching and surface adsorption; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. The LC_{50} for norflurazon is >200 mg/L for catfish and goldfish (Hartley and Kidd, 1987). The only norflurazon surface water concentration detected (0.029 μg/L at S140) is several orders of magnitude below the calculated chronic action level. Using these criteria, these observed concentrations should not have an acute, detrimental impact on fish or aquatic invertebrates. Norflurazon was not detected in the sediment.

Simazine: Simazine is a selective systemic herbicide registered for use on many crops including sugarcane, citrus, corn, and non-crop areas. Environmental fate and toxicity data in Tables 4 and 5 indicate that simazine (1) is easily lost from soil by leaching and has a moderate potential for loss due to surface adsorption and surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data include a 96-

hour LC_{50} of 49 mg/L for guppies (Hartley and Kidd, 1987). Most of the aquatic biological effects occur at concentrations > 500 µg/L (Verschueren, 1983). Aquatic invertebrate LC_{50} toxicity ranges from 3.2 mg/L to 100 mg/L for simazine (U.S. EPA, 1984). The only surface water concentration of simazine detected (0.010 µg/L at S5A) was below any level of concern for fish or aquatic invertebrates. No simazine was detected in the sediment.

Quality Assurance Evaluation

Replicate samples were collected at locations S177 and S191. All the analytes detected in the surface water had precision ≤ 30 percent relative percent difference. No pesticide analytes were detected in the equipment blanks performed at S18C, S191, S331, S3, US41-25, and S5A. All of the collected samples were shipped and all bottles were received.

Glossary

Bioconcentration Factor: The ratio of the concentration of a contaminant in an aquatic organism to the concentration in water, after a specified period of exposure via water only. The duration of exposure should be sufficient to achieve a near steady-state condition.

EC_{50}: A concentration necessary for 50 percent of the aquatic species tested to exhibit a toxic effect short of mortality (e.g., swimming on side or upside down, cessation of swimming) within a short (acute) exposure period, usually 24 to 96 hours.

Henry's law constant (H): Relates the concentration of a compound in the gas phase to its concentration in the liquid phase. The constant is calculated from the formula: $H = P_{vp}/S$ where P_{vp} is pressure in atmospheres and S is solubility in moles/meter^3 for a compound.

K_{oc}: The soil/sediment partition or sorption coefficient normalized to the fraction of organic carbon in the soil. This value provides an indication of the chemical's tendency to partition between soil organic carbon and water.

LC_{50}: A concentration which is lethal to 50 percent of the aquatic animals tested within a short (acute) exposure period, usually 24 to 96 hours.

LD_{50}: The dosage which is lethal to 50 percent of the terrestrial animals tested within a short (acute) exposure period, usually 24 to 96 hours.

Method Detection Limits (MDLs): The minimum concentration of an analyte that can be detected with 99 percent confidence of its presence in the sample matrix.

Practical Quantitation Limits (PQLs): The lowest level of quantitation that can be reliably achieved within specified limit of precision and accuracy during routine laboratory operating conditions. The PQLs are further verified by analyzing spike concentrations whose relative standard deviation in 20 fortified water samples is < 15 percent. In general, PQLs are 2 to 5 times larger than the MDLs.

Probable Effect Concentration (PEC): The probable effect concentration is intended to identify concentrations above which harmful effects to sediment-dwelling organisms are likely to be frequently or always observed.

Soil or water half-life: The time required for one-half the concentration of the compound to be lost from the water or soil under the conditions of the test.

Threshold Effect Concentration (TEC): The threshold effect concentration is intended to identify concentrations below which harmful effects to freshwater sediment-dwelling organisms are unlikely to be observed.

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Figure 1. South Florida Water Management District Pesticide Monitoring Network.

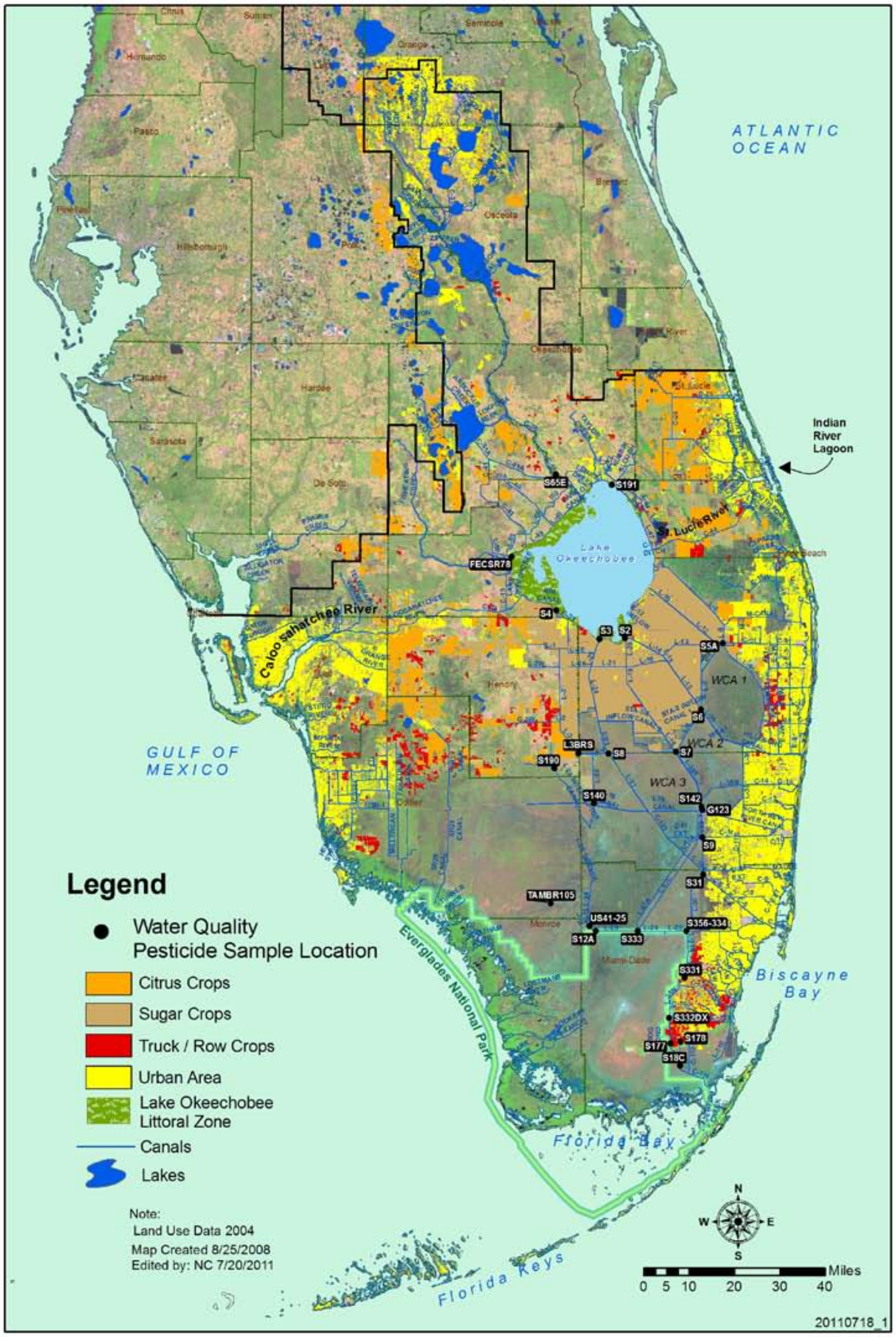

Table 1. Method detection limits (MDLs) and practical quantitation limits (PQLs) for April 2011 sampling event.

Pesticide or metabolite	Water: range of MDLs -PQLs (µg/L)	Sediment: range of MDLs - PQLs (µg/Kg)	Pesticide or metabolite	Water: range of MDLs -PQLs (µg/L)	Sediment: range of MDLs - PQLs (µg/Kg)
2,4-D	0.2 - 0.62	9 - 190	endrin aldehyde	0.0042 - 0.016	0.93 - 27
2,4,5-T	0.2 - 0.62	9 - 190	ethion	0.0095 - 0.04	2.3 - 67
2,4,5-TP (silvex)	0.2 - 0.62	9 - 190	ethoprop	0.0095 - 0.04	2.3 - 67
acifluorfen	0.2 - 0.62	9 - 190	fenamiphos	0.038 - 0.16	4.6 - 130
alachlor	0.057 - 0.24	14 - 400	fonofos	0.0095 - 0.04	2.3 - 67
aldrin	0.0019 - 0.008	0.46 - 13	heptachlor	0.0023 - 0.0096	0.46 - 13
ametryn	0.0095 - 0.04	2.3 - 67	heptachlor epoxide	0.0019 - 0.008	0.46 - 13
atrazine	0.0095 - 0.2	2.3 - 67	hexazinone	0.019 - 0.08	4.6 - 130
atrazine desethyl	0.0095 - 0.048	N/A	imidacloprid	0.21 - 0.71	N/A
atrazine desisopropyl	0.0095 - 0.04	N/A	linuron	0.21 - 0.71	8.3 - 180
azinphos methyl	0.028 - 0.12	6.9 - 200	malathion	0.028 - 0.12	4.6 - 130
α-BHC (alpha)	0.0021 - 0.0088	0.46 - 13	metalaxyl	0.047 - 0.2	N/A
β-BHC (beta)	0.0032 - 0.014	0.46 - 13	methamidophos	N/A	23 - 670
δ-BHC (delta)	0.0019 - 0.01	0.93 - 27	methoxychlor	0.0095 - 0.04	2.3 - 67
γ-BHC (gamma) (lindane)	0.0019 - 0.008	0.46 - 13	metolachlor	0.057 - 0.24	14 - 400
bromacil	0.047 - 0.3	9.3 - 270	metribuzin	0.019 - 0.08	4.6 - 130
butylate	0.019 - 0.08	N/A	mevinphos	0.057 - 0.24	9.3 - 270
carbophenothion (trithion)	0.015 - 0.064	2.3 - 67	mirex	0.011 - 0.048	1.9 - 53
chlordane	0.019 - 0.08	6.9 - 200	monocrotophos	N/A	23 - 670
chlorothalonil	0.015 - 0.064	2.3 - 67	naled	0.076 - 0.32	19 - 530
chlorpyrifos ethyl	0.0095 - 0.04	2.3 - 67	norflurazon	0.019 - 0.08	4.6 - 130
chlorpyrifos methyl	0.019 - 0.08	4.6 - 130	parathion ethyl	0.019 - 0.08	4.6 - 130
cypermethrin	0.019 - 0.08	2.3 - 67	parathion methyl	0.019 - 0.08	4.6 - 130
DDD-P,P'	0.0046 - 0.019	0.93 - 27	PCB-1016	0.019 - 0.08	14 - 400
DDE-P,P'	0.0038 - 0.016	0.93 - 27	PCB-1221	0.019 - 0.08	9.3 - 270
DDT-P,P'	0.0057 - 0.024	1.4 - 40	PCB-1232	0.019 - 0.08	21 - 600
demeton	0.028 - 0.12	6.9 - 200	PCB-1242	0.019 - 0.08	14 - 400
diazinon	0.019 - 0.08	2.3 - 67	PCB-1248	0.019 - 0.08	9.3 - 270
dicofol (kelthane)	0.042 - 0.18	6.9 - 200	PCB-1254	0.019 - 0.08	9.3 - 270
dieldrin	0.0019 - 0.008	0.46 - 13	PCB-1260	0.019 - 0.08	14 - 400
disulfoton	0.019 - 0.08	2.3 - 67	permethrin	0.015 - 0.064	2.8 - 80
diuron	0.21 - 0.71	8.3 - 180	phorate	0.0095 - 0.04	2.3 - 67
α-endosulfan (alpha)	0.0038 - 0.016	0.46 - 13	prometryn	0.019 - 0.08	4.6 - 130
β-endosulfan (beta)	0.0038 - 0.016	0.46 - 13	prometon	0.019 - 0.08	N/A
endosulfan sulfate	0.0046 - 0.02	0.93 - 27	simazine	0.0095 - 0.04	2.3 - 67
endrin	0.0095 - 0.04	2.3 - 67	toxaphene	0.095 - 0.4	35 - 1000
			trifluralin	0.0076 - 0.032	1.9 - 53

N/A - not analyzed

Table 2. Summary of pesticide residues (µg/L) detected above the method detection limit in surface water samples collected by SFWMD in April 2011.

Date	Location	Flow	ametryn	atrazine	atrazine desethyl	hexazinone	norflurazon	simazine	Number of compounds detected at location
4/25/2011	FECSR78	N	-	0.099	-	0.11	-	-	2
	S177	N	-	0.041 *	-	-	-	-	1
	S178	N	-	-	-	-	-	-	0
	S18C	N	-	-	-	-	-	-	0
	S191	N	-	0.035 I *	-	0.25 *	-	-	2
	S331	N	-	-	-	-	-	-	0
	S332DX	N	-	0.058	-	-	-	-	1
	S65E	Y	-	0.021 I	-	-	-	-	1
4/26/2011	S12A	N	-	-	-	-	-	-	0
	S2	N	-	0.29	0.031 I	-	-	-	2
	S3	N	-	0.27	0.030 I	-	-	-	2
	S31	N	-	-	-	-	-	-	0
	S333	Y	0.020 I	0.17	0.016 I	-	-	-	3
	S356-334	Y	0.019 I	0.16	0.018 I	-	-	-	3
	S4	N	-	0.30	0.031 I	-	-	-	2
	S9	N	-	-	-	-	-	-	0
	TAMBR105	N	-	-	-	-	-	-	0
	US41-25	N	-	-	-	-	-	-	0
4/27/2011	G123	N	-	-	-	-	-	-	0
	L3BRS	Y	0.021 I	0.56	0.056	-	-	-	3
	S140	N	-	0.027 I	-	-	0.029 I	-	2
	S190	N	-	0.20	0.024 I	-	-	-	2
	S7	N	0.015 I	0.46	0.044	-	-	-	3
	S8	N	0.032 I	2.2	0.11	-	-	-	3
4/28/2011	S5A	Y	-	0.20	0.034 I	-	-	0.010 I	3
	S6	N	0.037 I	0.69	0.048	-	-	-	3
Total number of compound detections			6	17	11	2	1	1	38

N - no Y - yes R - reverse; - denotes that the result is below the method detection limit; * results are the average of replicate samples
I - value reported is less than the practical quantitation limit, and greater than or equal to the method detection limit

Table 3. Summary of pesticide residues (µg/Kg) detected above the method detection limit in sediment samples collected by SFWMD in April 2011.

Date	Location	Flow	DDD-p,p'	DDE-p,p'	alpha endosulfan	beta endosulfan	endosulfan sulfate	Number of compounds detected at location
4/25/2011	S177	N	-	8.3 I	-	-	-	1
	S178	N	-	15	2.1 I	2.1 I	8.4 I	4
4/26/2011	S2	N	13 I	***56***	-	-	-	2
	S3	N	2.9 I	14	-	-	-	2
	S31	N	-	1.6 I	-	-	-	1
	S4	N	-	11 I	-	-	-	1
4/27/2011	G123	N	-	14	-	-	-	1
	S7	N	-	11	-	-	-	1
4/28/2011	S5A	Y	-	4.6	-	-	-	1
	S6	N	1.2 I	6.5	-	-	-	2
Total number of compound detections			3	10	1	1	1	16

N - no Y - yes R - reverse; - denotes that the result is below the method detection limit
I - value reported is less than the practical quantitation limit, and greater than or equal to the minimum detection limit
Values in bold, italicized font are at a concentration that harmful effects to sediment-dwelling organisms are likely to be frequently or always observed.

Table 4. Selected properties of pesticides detected during the April 2011 sampling event.

Common Name	Surface Water Standards F.A.C. 62-302 (µg/L)	Acute Oral LD_{50} For Rats (mg/kg) (1)	U.S. EPA Carcinogenic Potential	Water Solubility (WS) (mg/L) (2, 3)	Koc (mL/g) (2, 3)	Soil Half-life (days) (2, 3)	Soil Conservation Service (SCS) rating (2)			Volatility from Water	Bioconcentration Factor (BCF)
							LE	SA	SS		
ametryn	-	1,110	D	185	300	60	M	M	M	I	33
atrazine	-	3,080	C	33	100	60	L	M	L	I	86
DDD-p,p'	-	3,400	-	0.055	239,900	-	-	-	-	I	3,173
DDE-p,p'	-	880	-	0.065	243,220	-	-	-	-	S	2,887
alpha endosulfan	0.056	70	-	0.53	12,400	50	XS	L	M	S	884
beta endosulfan		70	-	0.28	-	-	-	-	-	S	1,267
endosulfan sulfate	-	-	-	0.117	-	-	-	-	-	I	2,073
hexazinone	-	1,690	D	33,000	54	90	L	M	M	I	2
norflurazon	-	9,400	C	28	700	90	M	M	L	I	94
simazine	-	>5,000	C	6.2	130	60	L	M	M	I	221

SCS Ratings are pesticide loss due to leaching (LE), surface adsorption (SA) or surface solution (SS) and grouped as large(L), medium (M), small (S) or extra small (XS)
Volatility from water: R = rapid, I = insignificant, S = significant
Bioconcentration Factor (BCF) calculated as BCF = $10^{\wedge(2.791 - 0.564 \log WS)}$ (4)
B2: probable human carcinogen; C: possible human carcinogen; D: not classified; E: evidence of non-carcinogen for humans (5)
FDEP F.A.C. 62-302 surface water standards (4/2008) for Class III waters except Class I in ( )
Note: endosulfan usually considered the sum of alpha and beta isomers

(1) Hartley and Kidd (1987)
(2) Goss and Wauchope (1992)
(3) Montgomery (1993)
(4) Lyman e al. (1990)
(5) U.S. EPA (1996a)

Table 5 . Toxicity of pesticides detected during the April 2011 sampling event to freshwater aquatic invertebrates and fishes (µg/L).

Common Name	48 hr EC_{50} Water flea *Daphnia magna*	Acute Toxicity (*)	Chronic Toxicity (*)	96 hr LC_{50} Fathead Minnow (#) *Pimephales promelas*	Acute Toxicity	Chronic Toxicity	96 hr LC_{50} Bluegill *Lepomis macrochirus*	Acute Toxicity	Chronic Toxicity	96 hr LC_{50} Largemouth Bass *Micropterus salmoides*	Acute Toxicity	Chronic Toxicity	96 hr LC_{50} Rainbow Trout (#) *Oncorhynchus mykiss*	Acute Toxicity	Chronic Toxicity	96 hr LC_{50} Channel Catfish *Ictalurus punctatus*	Acute Toxicity	Chronic Toxicity
ametryn	28,000 (7)	9,333	1,400	16,000 (8)	5,333	800	4,100 (4)	1,367	205	-	-	-	8,800 (4)	2,933	440	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	3,600 (8)	1,200	180	-	-	-
atrazine	6,900 (7)	2,300	345	15,000 (7)	5,000	750	16,000 (4)	5,333	800	-	-	-	8,800 (4)	2,933	440	7,600 (4)	2,533	380
	-	-	-	-	-	-	-	-	-	-	-	-	5,300 (9)	1,767	265	-	-	-
DDD-p,p'	3,200 (6)	1,067	160	4,400 (1)	1,467	220	42 (1)	14	2.1	42 (1)	14	2.1	70 (1)	23.3	4	1,500 (1)	500	75
DDE-p,p'	-	-	-	-	-	-	240 (1)	80	12	-	-	-	32 (1)	10.7	2	-	-	-
endosulfan	166 (7)	55	8	1 (1)	0.3	0.05	1 (1)	0.33	0.05	-	-	-	1 (1)	0.33	0.05	1 (1)	0.33	0.05
	-	-	-	-	-	-	2 (3)	0.67	0.10	-	-	-	3 (2)	1	0.15	1.5 (7)	0.5	0.08
	-	-	-	-	-	-	-	-	-	-	-	-	1 (3)	0.33	0.05	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	0.3 (5)	0.10	0.02	-	-	-
	166 (10)	55	8	1.5 (10)	0.5	0.08	1.7 (10)	0.57	0.09	-	-	-	0.8 (10)	0.27	0.04	-	-	-
hexazinone	151,600 (7)	50,533	7,580	274,000 (4)	91,333	13,700	100,000 (7)	33,333	5,000	-	-	-	180,000 (7)	60,000	9,000	-	-	-
	151,600 (11)	50,533	7,580	274,000 (11)	91,333	13,700	505,000 (11)	168,333	25,250	-	-	-	>320,000 (11)	>106,667	>16,000	-	-	-
norflurazon	15,000 (7)	5,000	750	-	-	-	16,300 (7)	5,433	815	-	-	-	8,100 (7)	2,700	405	>200,000 (4)	>67,000	>10,000
	>15,000 (12)	>5,000	>750	-	-	-	16,300 (12)	5,433	815	-	-	-	8,100 (12)	2,700	405	-	-	-
simazine	1,100 (7)	367	55	100,000 (7)	33,333	5,000	90,000 (4)	30,000	4,500	-	-	-	100,000 (7)	33,333	5,000	-	-	-

(*) Florida Administrative Code (F.A.C.) 62-302.200, for compounds not specifically listed, acute and chronic toxicity standards are calculated as one-third and one-twentieth, respectively, of the amount lethal to 50% of the test organisms in 96 hours, where the 96 hour LC_{50} is the lowest value which has been determined for a species significant to the indigenous aquatic community.
(#) Species is not indigenous. Information is given for comparison purposes only.

(1) Johnson and Finley (1980)
(2) U.S. EPA (1977)
(3) Schneider (1979)
(4) Hartley and Kidd (1987)
(5) Montgomery (1993)
(6) Verschueren (1983)
(7) U.S. EPA (1991)
(8) U.S. EPA (2005)
(9) U.S. EPA (2006)
(10) U.S. EPA (2002)
(11) U.S. EPA (1994)
(12) U.S. EPA (1996b)

Table 6. Atrazine Desethyl/Atrazine ratio (DAR) data for April 2011 sampling event.

Date	Location	Flow*	atrazine		atrazine desethyl		DAR
			µg/l	moles/l	µg/l	moles/l	
4/26/2011	S2	N	0.29	1.34455E-09	0.031	1.65217E-10	0.1
	S3	N	0.27	1.25182E-09	0.03	1.59888E-10	0.1
	S333	Y	0.17	7.88186E-10	0.016	8.52735E-11	0.1
	S356-334	Y	0.16	7.41822E-10	0.018	9.59327E-11	0.1
	S4	N	0.3	1.39092E-09	0.031	1.65217E-10	0.1
4/27/2011	L3BRS	Y	0.56	2.59638E-09	0.056	2.98457E-10	0.1
	S190	N	0.2	9.27278E-10	0.024	1.2791E-10	0.1
	S7	N	0.46	2.13274E-09	0.044	2.34502E-10	0.1
	S8	N	2.2	1.02001E-08	0.11	5.86256E-10	0.1
4/28/2011	S5A	Y	0.2	9.27278E-10	0.034	1.81206E-10	0.2
	S6	N	0.69	3.19911E-09	0.048	2.55821E-10	0.1

DAR	All sites	Flow only sites	No flow sites
average	0.1	0.1	0.1
median	0.1	0.1	0.1
minimum	0.1	0.1	0.1
maximum	0.2	0.2	0.1

* N - no; Y - yes; R - reverse