Table 3.1. April 2009 nutrient concentrations and radium activities from the Caloosahatchee River Estuary groundwater study.

Station ID	Sample Type	Latitude (°N)	Longitude (°W)	Salinity	SiO_4^-	PO_4^{3-}	$NO_3^-+NO_2^-$	NH_4^+	TDN	^{224}Ra	^{223}Ra	^{226}Ra	^{228}Ra	Water Age (days)
					(μmol L^{-1})					(dpm 100 L^{-1})				
G1	GoM surface	26.4182	-82.0190	36.36	4.5	<0.05	0.00	3.7		5.5	4.0	36.8	19.0	23.9
G3	GoM surface	26.4160	-82.2061	36.28	2.6	<0.05	0.08	3.8	9.3	3.3	1.1	22.1	9.4	18.9
G5	GoM surface	26.3040	-81.9541	36.61	7.8	<0.05	<0.05	4.2		6.7	6.7	61.7	36.9	41.8
G6	GoM surface	26.4353	-81.9631		3.0	<0.05	0.16	5.2	29.1	24.4	13.2	74.1	42.4	9.5
G7	GoM surface	26.3470	-81.8780		4.0	<0.05	<0.05	4.2	20.6	10.5	11.2	68.4	36.1	23.8
G8	GoM surface	26.3612	-82.1631	36.34	10.7	0.10	0.51	5.9	10.6	2.0	1.4	18.8	8.0	28.7
G11	GoM surface	26.3087	-82.0963	36.26	5.6	0.40	<0.05	5.5		5.6	4.6	47.2	21.2	27.0
Mudhole	GoM surface	26.2523	-82.0027	36.45	5.1	0.00	0.54	3.0		4.2	4.5	55.7	29.2	54.0
C1	Cal. Estuary	26.6781	-81.8385	9.54	23.2	1.67	1.07	1.3		19.5	10.7	290.4	36.2	10.5
C2	Cal. Estuary	26.6973	-81.7991	5.46	15.5	1.11	3.69	3.8	34.0	13.1	6.7	280.7	33.9	16.7
C3	Cal. Estuary	26.7215	-81.7339	3.26	23.7	1.64	4.61	3.9	48.4	6.5	17.4	195.1	20.3	21.5
C4	Cal. Estuary	26.7234	-81.7006	2.52	54.6	3.01	7.62	4.2	68.2	7.4	4.7	190.8	20.4	18.1
C5	Cal. Estuary	26.4837	-82.0156	35.82	19.3	0.60	0.54	5.0		38.6	21.0	103.4	47.9	5.2
C6	Cal. Estuary	26.5232	-82.0076	32.87	17.2	0.60	0.71	9.3	27.0	33.9	23.7	200.7	62.5	10.4
C7	Cal. Estuary	26.5312	-81.9597	27.78	19.6	0.99	0.29	5.6		23.9	27.9	287.1	68.6	19.1
C8	Cal. Estuary	26.5573	-81.9301	24.88	10.3	0.92	0.36	5.4	40.4	21.2	18.3	381.8	74.7	24.6
C9	Cal. Estuary	26.6094	-81.8964	19.75	18.6	1.85	0.40	2.1		25.2	14.8	508.0	78.9	21.4
C10	Cal. Estuary	26.6483	-81.8724	17.35	11.7	0.95	0.71	3.3		26.7	17.4	439.8	62.6	14.6
C11	Cal. River	26.7211	-81.6922	0.35	66.3	2.45	8.20	3.2	79.8	3.7	2.5	13.0	14.6	27.9
C12	Cal. River	26.7885	-81.3030	0.26	82.5	0.94	3.39	1.3	89.3	6.0	2.2	71.8	13.8	14.3
C13	Cal. River	26.8394	-81.0809	0.28	113.7	0.93	9.83	5.1	78.3	10.9	1.6	6.6	18.5	9.1
GW1	Monit. Well	26.6711	-81.8799	0.26	144.6	3.08	0.78	24.0	81.7	14.0	8.6	49.0	8.7	
GW2	Monit. Well	26.6711	-81.8799		62.8	3.85	0.32	130.7	169.4	214.2	41.5	485.2	279.9	
GW2B	Monit. Well	26.5100	-82.0846	40.00						709.7	143.4	2443.9	945.4	
GW3	Monit. Well	26.6397	-81.8689	0.40	60.2	0.62	0.58	10.4	29.7	38.3	12.4	428.1	32.2	
GW4	Monit. Well	26.5588	-81.8982	0.43	88.3	0.67	0.76	28.5	122.6	56.1	24.9	308.0	59.3	
GW5	Monit. Well	26.5238	-81.9202	1.53	154.1	0.57	0.65	76.5	92.0	58.3	48.5	735.0	87.6	
GW6	Monit. Well	26.5185	-81.9357	1.16	89.7	2.58	0.38	57.0	100.3	65.4	63.3	2160.8	90.4	
GW7	Monit. Well	26.7114	-81.8382	0.29	108.6	15.37	1.80	53.8	70.8	28.6	-0.4	86.3	15.6	
GW8	Monit. Well	26.7158	-81.8072	0.65	204.6	2.72	0.82	16.8	28.2	32.2	21.7	154.1	9.9	

GW9	Monit. Well	26.7332	-81.7128	0.39	166.7	0.70	0.30	63.3	88.4	32.1	43.9	1527.7	43.4
GW10	Monit. Well	26.7346	-81.7309	0.43	161.1	0.37	7.76	19.5	47.4	49.3	14.5	162.1	30.4
GW11	Monit. Well	26.7046	-81.6797	0.23	167.9	0.34	0.76	24.2	40.1	23.3	29.5	492.6	21.8
GW12	Monit. Well	26.6805	-81.7832	0.22	81.4	0.99	0.52	4.3	38.6	26.3	13.2	128.8	21.2
GW13	Monit. Well	26.5238	-81.9202	0.37	229.5	0.40	0.55	15.5	40.4	11.8	0.1	255.5	24.3
GW14	Monit. Well	26.3339	-81.8046	3.64	239.5	0.38	0.10	26.9	36.1	93.6	272.3	3445.5	47.0
GW15	Monit. Well	26.3339	-81.8046	2.25	283.6	0.53	0.92	29.3	49.9	122.6	129.2	1214.3	79.5
GW16	Monit. Well	26.3339	-81.8046	0.80	99.7	2.09	3.33	97.7	189.0	139.6	28.6	342.6	94.3
GW17	Monit. Well	26.3875	-81.8262	0.37	32.8	3.17	0.68	26.3	48.4	139.4	12.2	141.7	129.6
GW18	Monit. Well	26.4419	-81.8346	0.25	62.5	0.35	0.94	29.9	45.7	52.9	28.9	234.9	20.3

Table 3.2. October 2009 nutrient concentrations and radium activities from the Caloosahatchee River Estuary groundwater study.

Station ID	Sample Type	Latitude (°N)	Longitude (°W)	Salinity	SiO_4^-	PO_4^{3-}	$NO_3^-+NO_2^-$	NH_4^+	TDN	^{224}Ra	^{223}Ra	^{226}Ra	^{228}Ra	Water Age (days)
						(μmol L^{-1})					(dpm 100 L^{-1})			
G1	GoM surface	26.4190	-82.0222	35.03	15.9	<0.05	0.1	0.8	18.2	8.1	5.8	63.6	24.7	20.7
G3	GoM surface	26.4160	-82.2061	35.39	18.3	0.0	0.2	1.0	16.1	8.6	4.8	55.1	22.3	16.8
G5	GoM surface	26.3038	-81.9540	35.89	6.6	<0.05	2.3	1.4	17.0	3.4	2.5	53.3	20.5	46.4
G6	GoM surface	26.4397	-81.9623		26.0	0.1	0.7	2.0	21.6	17.2	9.9	74.5	29.0	9.0
G7	GoM surface	26.3469	-81.8778	35.55	11.6	<0.05	0.5	0.4	22.2	6.7	4.8	71.7	28.2	30.8
G8	GoM surface	26.3612	-82.1630	36.14	5.5	<0.05	0.3	0.6	27.3	3.1	2.3	61.6	21.2	52.7
G11	GoM surface	26.3086	-82.0963	35.80	6.6	<0.05	0.6	1.7	12.8	20.5	2.0	52.0	19.1	2.6
C1	Cal. Estuary	26.6469	-81.8744	6.33	53.7	2.6	1.7	0.2	33.9	10.0	8.9	242.1	27.7	18.2
C2	Cal. Estuary	26.6707	-81.8482	2.20	46.5	2.8	2.8	0.5	28.2	3.3	3.3	144.8	11.7	24.5
C3	Cal. Estuary	26.6905	-81.8182	0.51	37.1	2.4	1.3	0.3	50.2	2.1	2.9	136.3	10.2	36.9
C4	Cal. Estuary	26.7215	-81.7308	0.34	55.3	2.5	7.1	1.9	45.8	2.2	3.3	120.9	10.1	33.6
C5	Cal. Estuary	26.4920	-82.0154	32.51	30.7	0.3	1.5	4.7	31.5	28.6	16.6	105.0	37.9	6.0
C6	Cal. Estuary	26.5242	-82.0055	33.17	64.2	0.6	1.0	0.3	21.8	29.4	16.1	131.6	46.4	8.1
C7	Cal. Estuary	26.5299	-81.9726	23.69	134.3	1.4	1.3	1.5	12.1	8.1	6.2	58.8	12.7	8.0
C8	Cal. Estuary	26.5410	-81.9414	16.50	128.2	2.4	2.4	1.1	31.5	18.3	14.6	164.5	32.9	10.0
C9	Cal. Estuary	26.5684	-81.9239	12.02	53.3	2.3	0.4	1.1	43.4	10.4	8.7	174.5	27.7	17.3
C10	Cal. Estuary	26.5887	-81.9065	8.82	36.5	1.9	1.2	0.3	26.7	9.6	9.8	200.5	24.6	16.5
C10B	Cal. Estuary	26.6270	-81.8924	5.20	28.7	3.2	<0.05	0.3	30.3	8.7	7.8	194.2	19.6	13.8
C10C	Cal. River	26.7228	-81.6960	0.44	137.3	3.2	1.1	5.1	44.3	2.8	3.7	188.6	11.8	
C11	Cal. River	26.7211	-81.6922	0.25	391.7	3.2	1.0	2.2	78.9	4.3	5.0	187.2	10.0	14.4
C12	Cal. River	26.7885	-81.3030	0.24	221.1	1.9	1.9	1.8	50.2	3.9	2.6	163.5	13.3	23.6
C13	Cal. River	26.8394	-81.0809	0.11	46.8	3.4	0.6	1.2	65.7	3.8	0.3	28.5	12.6	22.6
PZ1	Piezometer	26.6905	-81.8182		134.3	0.5	5.7	0.8	56.8					
PZ2	Piezometer	26.5255	-81.9983	30.29	157.5	5.0	1.5	4.8	75.9	121.0	45.5	143.8	142.3	
PZ3	Piezometer	26.5615	-81.9260	21.34	39.4	4.0	0.6	6.5	39.6	59.9	24.8	223.0	41.6	
GW1	Monit. Well	26.6711	-81.8799	0.37	75.2	0.5	0.6	25.6	47.9	29.5	13.3	98.0	13.6	
GW2	Monit. Well	26.6711	-81.8799	32.95	73.6	0.9	<0.05	42.7	152.0	472.6	150.5	890.8	249.7	
GW2b	Monit. Well	26.6397	-81.8689	5.43	34.2	0.1	0.8	21.6	131.7	217.9	30.2	126.8	90.7	
GW4	Monit. Well	26.5588	-81.8982	0.34	54.8	1.1	0.6	41.5	108.8	68.8	31.9	250.6	41.7	

GW5	Monit. Well	26.5238	-81.9202	2.46	136.0	0.6	0.4	76.1	130.3	282.9	131.5	164.0	187.6
GW6	Monit. Well	26.5185	-81.9357	0.82	56.9	0.7	0.3	67.9	124.0	148.4	54.8	1647.9	81.5
GW7	Monit. Well	26.7114	-81.8382	0.32	115.0	5.0	4.6	13.8	45.6	18.1	9.7	150.6	25.7
GW8	Monit. Well	26.7158	-81.8072	0.70	163.3	1.1	0.3	11.8	34.2	68.6	54.3	376.5	46.8
GW9	Monit. Well	26.7332	-81.7128	0.41	160.6	0.2	0.8	80.6	121.7	67.1	110.6	1432.3	36.3
GW10	Monit. Well	26.7346	-81.7309	0.60	187.8	0.3	1.0	24.6	55.4	64.1	49.4	192.3	25.0
GW11	Monit. Well	26.7046	-81.6797	0.28	143.9	0.2	0.2	23.3	43.6	31.0	26.2	398.7	20.2
GW12	Monit. Well	26.6805	-81.7832	0.23	82.2	1.4	0.3	8.4	36.2	40.7	22.4	152.8	27.3
GW13	Monit. Well	26.5238	-81.9202	0.37	183.4	76.2	0.2	5.4	15.1	148.4	4.9	306.2	24.8
GW14	Monit. Well	26.3339	-81.8046	2.13	179.9	0.6	0.9	29.4	57.9	130.6	100.2	903.6	74.5
GW15	Monit. Well	26.3339	-81.8046	3.54	88.6	0.1	0.1	14.3	60.5	-6.3	282.9	2731.4	38.5
GW16	Monit. Well	26.3339	-81.8046	0.93	102.7	2.4	0.9	39.0	149.4	196.8	21.9	255.3	93.0
GW17	Monit. Well	26.3875	-81.8262	0.44	26.8	4.1	0.5	25.0	55.1	175.7	14.4	126.1	122.7
GW18	Monit. Well	26.4419	-81.8346	0.24	67.3	0.3	2.5	25.0	51.6	49.1	33.7	273.2	27.5

Table 3.3. Estimates of groundwater discharge to the Caloosahatchee River Estuary.

Method	Apr-09	Oct-09
	(10^6 m^3/day)	
SGD (Ra isotopes)[1]	3.33	1.27
SGD (Water Balance)[2]	4.33	2.80
Estuarine Salt Balance	3.85	4.44
Franklin Lock Discharge[3]	1.84	1.93

[1]Franklin Lock to Gulf of Mexico inlet

[2]Does not account for anthropogenic withdrawls and includes input landward of the Franklin Lock

[3]Mean daily flow for 2.5 weeks preceeding the field study

Table 3.4. Estimates of groundwater and Franklin Lock nutrient flux to the Caloosahatchee River Estuary.

	Apr-09		Oct-09		Apr-09	Oct-09
	SGD	Franklin Lock	SGD	Franklin Lock	Groundwater/Franklin Lock Flux	
	(kg/day)					
TDN	3410	2100	1400	2100	162%	67%
DIN	1960	303	582	85	647%	685%
PO4	222	160	209	200	139%	104%

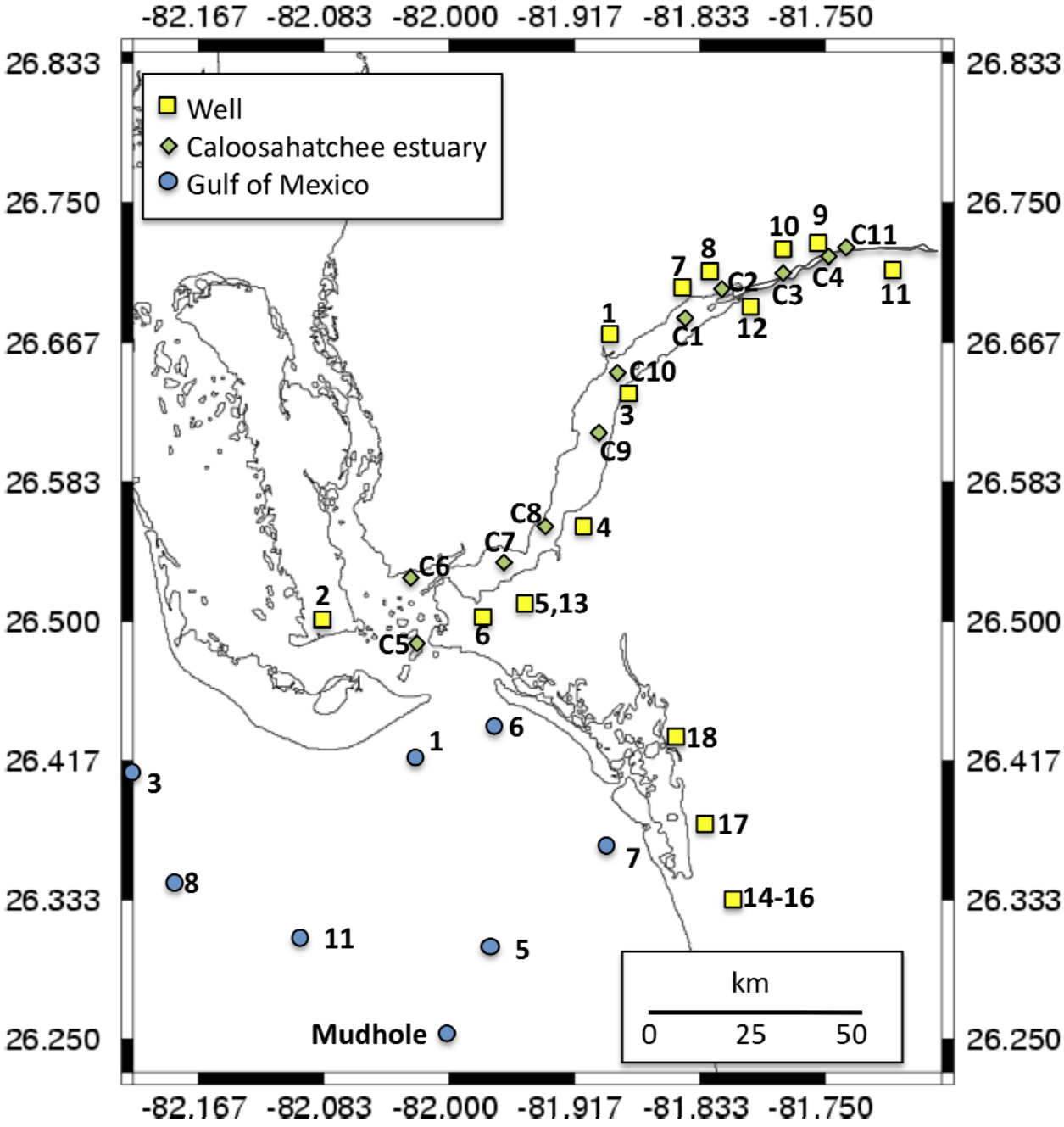

Figure 3.1. Map of the study area including station locations.

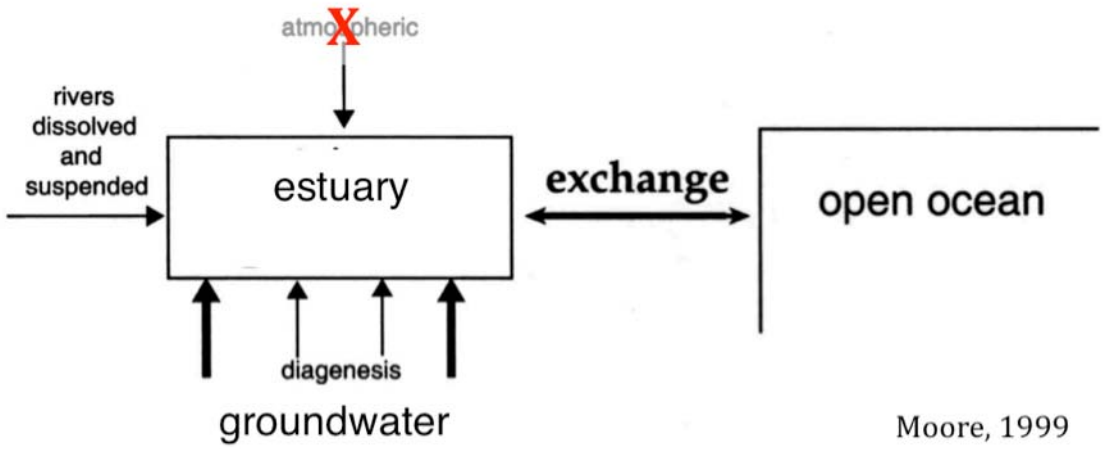

Figure 3.2. Box model illustration for application of radium isotopes for quantifying submarine groundwater discharge.