11643 Pride Port Hudson Rd.
Zachary, LA 70791
225-654-8847
225-658-0029 fax

Comite Resources, Inc.

Louisiana Department of Environmental Quality
Office of Environmental Services
Permits Division
Municipal and General Water Permits Section
P.O. Box 4313
Baton Rouge, LA 70821-4313

August 31, 2009

Re: Hammond Wetland Assimilation Monitoring Annual Report 2008-2009

Dear Sir:,

The purpose of this letter is to submit Hammond's Wetland Assimilation Monitoring Annual report. If you have any questions please telephone 225-654-8847 or e-mail lindseyj@bellsouth.net.

Sincerely,

Joel Lindsey
Principal

Cc: Office of Environmental Compliance
Enforcement Division Attention: Permit Compliance Unit√

Louisiana Department of Environmental Quality
Office of Environmental Assessment
Water Quality Division
% Kris Pintado

LOUISIANA POLLUTANT DISCHARGE ELIMINATION SYSTEM (LPDES)

Wetland System Monitoring Requirement

for

City of Hammond
Wetland Assimilation Project

Comite Resources, Inc.

2008 Annual Wetland Monitoring Report

Date: August 31, 2009

ANNUAL WETLAND MONITORING REPORT
Summary Sheet

City of Hammond
310 East Charles St.
Hammond, Louisiana 70404-2788

Permit Number: LA0032328
Agency Interest Number: AI19578

The city of Hammond is located in eastern Louisiana in Tangipahoa Parish, 58 miles north of New Orleans, and 45 miles east of Baton Rouge. The South Slough wetlands are located approximately seven miles southeast of Hammond, and are bordered to the north by South Slough canal, to the west by Highway 51 and I-55, and to the east and south by the Joyce Wildlife Management Area (JWMA). A wastewater distribution system running east-west on the south side of the spoil bank along South Slough disperses effluent evenly along the northern edge of the wetlands. Wastewater is prevented from entering South Slough canal. The JWMA, south of the wetland discharge site, receives water after passing through the South Slough wetlands. The JWMA is bordered to the north by uplands, to the west by Highway 51 and I-55, to the south by Pass Manchac, and to the east by Lake Pontchartrain and the Tangipahoa River.

Hammond's treatment system has a design capacity of 8 million gallons per day (MGD). Influent wastewater is collected and passed through the South WWTP headworks and then piped to a three-cell oxidation lagoon located on the north side of C. M. Fagan Drive. After this, effluent is disinfected prior to transportation via force main. Dechlorination occurs near the City of Ponchatoula's wastewater treatment plant prior to discharge directly into South Slough wetlands; thence into the Joyce Wildlife Management Area Wetlands; thence into Lake Pontchartrain.

The outfall distribution system is comprised of 3,600 LF of aerial piping laid out from west to east. The distribution system is constructed on pilings along the south bank of South Slough. Treated sanitary effluent is discharge directly into South Slough Wetlands; thence into the Joyce Wildlife Management Area Wetlands; thence into Lake Pontchartrain.

In order to effectively monitor the effect of this discharge on the floral and faunal components in the receiving wetlands, several study locations were identified and delineated. The region

surrounding the wastewater distribution system was designated as the Treatment Site (Figure 1). The region where effluent will pass out of the Joyce Wildlife Management Area into Middle Bayou was designated as the OUT Site. Both the Treatment and OUT sites contain herbaceous vegetation. A study site was also established in the forested wetlands south of the treatment site, designated as MID Site. Two control sites, one forested and one marsh, were also established in hydrologically isolated but ecologically similar wetlands located nearby (Figure 1). The forested wetland control site, referred to as Forested Control in this document, is located just west of Black Bayou. The marsh control site, referred to as Marsh Control in this document, is located near the southeastern corner of the JWMA. Establishment of study sites, installation of equipment, and monitoring at the Hammond wetland assimilation project by Comite Resources, Inc. began in the late spring/summer of 2006.

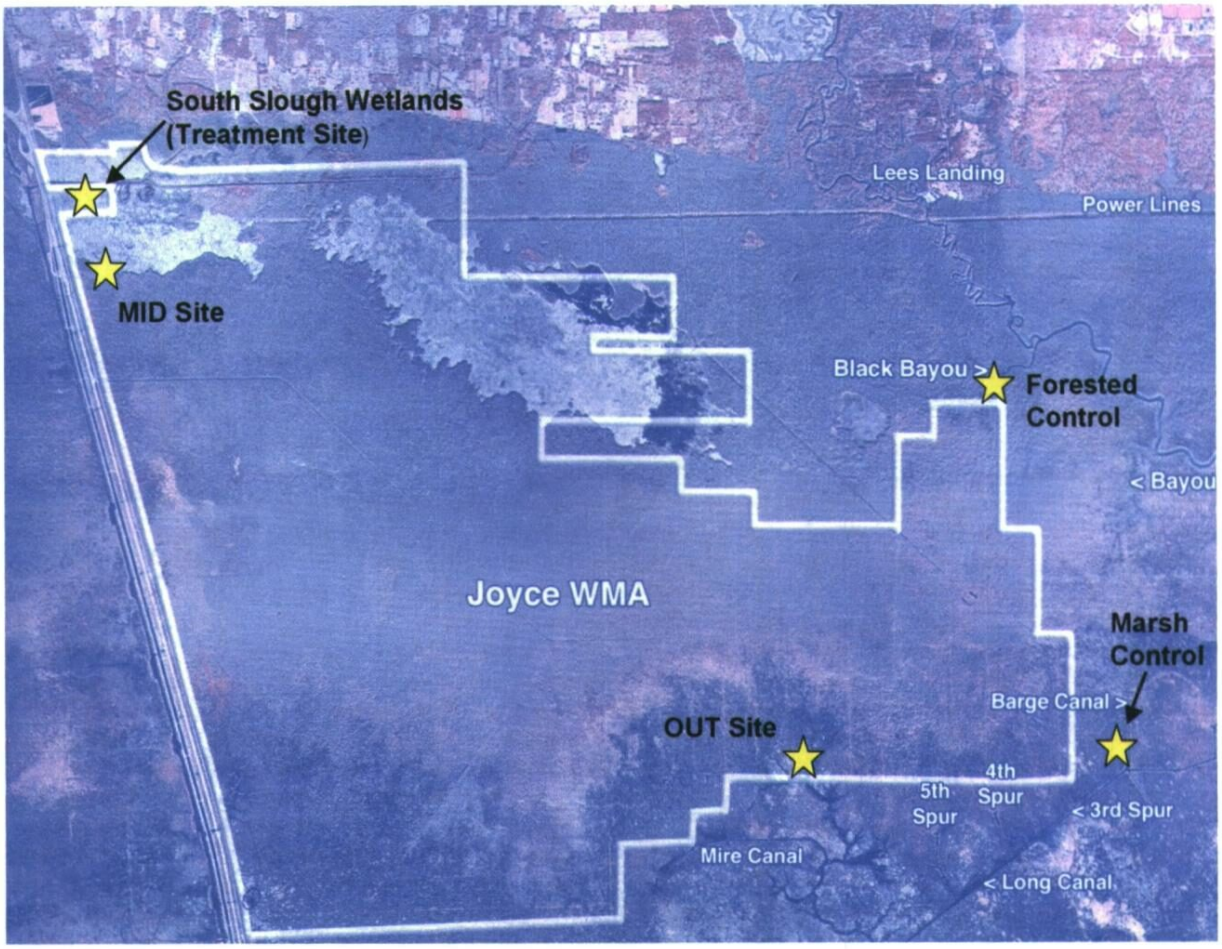

Figure 1. Map showing the Hammond assimilation wetland study site locations.

GROWTH STUDIES ~ STEM GROWTH (Flora)

Plots for measuring perennial productivity were established in the MID and Forested Control sites. At each site, three 10 x 33-m plots were designated. Within each plot, trees > 2.5 cm in diameter at breast height (DBH) were tagged. To estimate biomass, DBH was measured initially when trees were dormant and then re-measured again one year later. Biomass for each species was estimated by applying recorded DBH measurements to published regression equations. Change in biomass represents annual stem production and, when added to annual leaf litterfall, provides an estimation of aboveground net primary production in each forested plot.

PARAMETER	GROWTH STUDIES ~ STEM GROWTH (Flora)					
	Wastewater Management Area (g/m²/yr) (mean ± standard error)			Control Area (g/m²/yr) (mean ± standard error)		
	UAA Overall Average	Current Overall Average	Difference[1]	UAA Overall Average	Current Overall Average	Difference[1]
Tmt Area 2 (MID)	509.4±31.6	199.2±47.4	2			
Forested Control				245.4±29.2	117.6±30.2	2

[1] The difference in the UAA value and the Current value shall be indicated by **NO INCREASE = 0, INCREASE = 1, or DECREASE = 2.**

ANALYSIS OF VARIANCE (ANOVA)

Was there a significant difference (p=0.05) between stem growth (flora) in the control and the treatment area?

☐ YES ✓ NO

If yes, please explain the significance between the control and the treatment areas and outline any corrective actions taken, if needed.

There was no significant difference detected among stem growth in the Mid and the Forested Control sites (P = 0.2203). Stem growth measured in 2008 was lower than in the pre-discharge period in both the Mid and Control sites. Because a decrease in productivity was observed in both the Mid and Control sites, it is assumed to be due to environmental factors and not due to treated effluent.

GROWTH STUDIES ~ LITTER FALL (Flora)

Two 10 x 100 m quadrates, divided into three 10 x 33.3 m subplots, were established at the Mid and Forested Control sites. Two 0.25 m^2 leaf litter boxes, with screened bottoms and approximately 10 cm wide sides, were placed randomly in each subplot. Leaves and other materials collected in the boxes were gathered monthly. The term 'leaf litter' is used in reference to all non-woody litter including flowers, fruits, and seeds that typically account for < 10% of the non-woody litterfall total. Large stems and sticks were removed from the litter, and the cleaned litter was dried to constant mass at 65°C and weighed.

PARAMETER	GROWTH STUDIES ~ LITTER FALL (Flora)					
	Wastewater Management Area (g/m²/yr) (mean ± standard error)			Control Area (g/m²/yr) (mean ± standard error)		
	UAA Total Dry Weight	Current Total Dry Weight	Difference[1]	UAA Total Dry Weight	Current Total Dry Weight	Difference[1]
Tmt Area 2 (MID)	781.5±62.0	467.4±51.0	2			
Forested Control				578.6±65.6	243.9±18.2	2

[1] The difference in the UAA value and the Current value shall be indicated by NO INCREASE = 0, INCREASE = 1, or DECREASE = 2.

ANALYSIS OF VARIANCE (ANOVA)

Has there been a significant difference (p=0.05) between the Litter Fall (Flora) in the control and the treatment area?

✓ YES ☐ NO

If yes, please explain the significance between the control and the treatment areas and outline any corrective actions taken, if needed.

Mean annual leaf litter was significantly higher in the Mid site than in the Control site (P = 0.0020). Litterfall and stem growth are added together to calculate net primary productivity (NPP). NPP is affected by nutrient availability and the Mid site is receiving nutrients from the discharge of treated effluent. Mean leaf litter is lower in both the Mid and Control sites in 2008 than in the pre-discharge period. Because productivity declined in the Control as well as the site receiving discharge of treated effluent, this response is most likely due to an environmental factor (e.g., decline in rainfall, etc) rather than the effluent itself.

GROWTH STUDIES ~ Marsh Productivity

At each non-forested marsh study site, end of season live (EOSL) biomass was measured using five randomly placed 0.25 m^2 quadrats. Clip plot samples were collected 10 to 20 m from the bayou edge in an area of relatively homogenous herbaceous vegetation. Vegetation within the quadrat was cut as close to the marsh surface as possible, stored in labeled paper bags, brought back to the laboratory, and refrigerated until processed. Live material was separated from dead, and dried at 60°C to a constant weight. All data are presented as live dry weight per square meter basis (g dry wt m^{-2}), and is representative of aboveground net primary productivity (NPP).

PARAMETER	GROWTH STUDIES ~ Marsh Productivity					
	Wastewater Management Area (g/m²/yr) (mean ± standard error)			Control Area (g/m²/yr) (mean ± standard error)		
	UAA Total Dry Weight	Current Total Dry Weight	Difference[1]	UAA Total Dry Weight	Current Total Dry Weight	Difference[1]
Tmt Area 1 (TMT)	1410.0±214.9	604.8±37.8	2			
Tmt Area 2 (OUT)	1399.8±215.1	1247.4±173.2	0			
Marsh Control				759.9±125.3	718.2±37.8	0

[1] The difference in the UAA value and the Current value shall be indicated by **NO INCREASE = 0, INCREASE = 1, or DECREASE = 2.**

ANALYSIS OF VARIANCE (ANOVA)

Has there been a significant difference (p=0.05) between the productivity (Flora) in the control and the treatment area?

✓ **YES** ☐ **NO**

If yes, please explain the significance between the control and the treatment areas and outline any corrective actions taken, if needed.

Mean productivity in the Out site was significantly higher than productivity in the Control or Treatment sites (0.0104). In addition, mean productivity was lower in the Treatment site in 2008 than in the pre-discharge period, but no difference was observed in the Out or Control sites. Productivity at the Treatment site decreased dramatically in 2007 due to the impact of heavy nutria grazing and low rainfall and this pattern was observed at the Out and Marsh Control sites as well.

Marsh standing crop was significantly higher in spring 2007, the first growing season of discharge. After spring 2007, there was a population explosion of nutria which grazed heavily

on the marsh. Most marsh out to 500 m from the discharge pipe was consumed by nutria in 2007. Hydrocotyl became the dominant species in the area, though it was found in low abundance prior to the nutria population explosion. Cutgrass has not been impacted by nutria. Exclosures have dense growth in them confirming that nutria are the cause of the impact on the marsh. Southeastern's Wetland Restoration Lab obtained a night-shoot permit to eliminate nutria at the Hammond site and over 2000 nutria have been killed. Since then, the marsh seems to be recovering.

WATER STAGES (Surface Water)

Water level recorders that were placed in the Treatment and Control sites were destroyed during Hurricane Katrina in 2006. The water level recorders were replaced in October 2007. Summary data are shown in the table below and in Figures 2 and 3.

Treatment		Control	
Water height (m)	Sample Date	Water height (m)	Sample Date
1/1/08	0.91	1/1/08	0.68
1/2/08	0.89	1/2/08	0.63
1/3/08	0.89	1/3/08	0.60
1/4/08	0.87	1/4/08	0.59
1/5/08	0.88	1/5/08	0.69
1/6/08	0.87	1/6/08	0.73
1/7/08	0.90	1/7/08	0.74
1/8/08	0.91	1/8/08	0.84
1/9/08	0.88	1/9/08	0.82
1/10/08	0.88	1/10/08	0.86
1/11/08	0.88	1/11/08	0.76
1/12/08	0.88	1/12/08	0.85
1/13/08	0.88	1/13/08	0.76
1/14/08	0.89	1/14/08	0.65
1/15/08	0.91	1/15/08	0.62
1/16/08	0.93	1/16/08	0.71
1/17/08	0.92	1/17/08	0.92
1/18/08	0.89	1/18/08	0.80
1/19/08	0.94	1/19/08	0.93
1/20/08	0.91	1/20/08	0.84
1/21/08	0.91	1/21/08	0.96
1/22/08	0.91	1/22/08	1.04
1/23/08	0.90	1/23/08	1.01
1/24/08	0.89	1/24/08	0.92
1/25/08	0.90	1/25/08	0.90
1/26/08	0.94	1/26/08	1.02
1/27/08	0.93	1/27/08	0.89
1/28/08	0.91	1/28/08	0.78
1/29/08	0.89	1/29/08	0.86
1/30/08	0.89	1/30/08	0.83
1/31/08	0.92	1/31/08	0.93
2/1/08	0.99	2/1/08	1.03
2/2/08	0.96	2/2/08	1.02

2/3/08	0.94	2/3/08	1.06
2/4/08	0.91	2/4/08	1.06
2/5/08	0.90	2/5/08	1.00
2/6/08	0.90	2/6/08	0.94
2/7/08	0.90	2/7/08	0.78
2/8/08	0.89	2/8/08	0.70
2/9/08	0.89	2/9/08	0.71
2/10/08	0.90	2/10/08	0.67
2/11/08	0.91	2/11/08	0.66
2/12/08	0.90	2/12/08	0.70
2/13/08	0.91	2/13/08	0.66
2/14/08	0.91	2/14/08	0.66
2/16/08	0.89	2/15/08	0.69
2/17/08	0.91	2/16/08	0.70
2/18/08	0.90	2/17/08	0.83
2/19/08	0.91	2/18/08	0.77
2/20/08	0.90	2/19/08	0.77
2/21/08	0.94	2/20/08	0.78
2/22/08	0.93	2/21/08	0.89
2/23/08	0.91	2/22/08	0.92
2/24/08	0.91	2/23/08	0.71
2/25/08	0.90	2/24/08	0.77
2/26/08	0.90	2/25/08	0.73
2/27/08	0.91	2/26/08	0.69
2/28/08	0.91	2/27/08	0.64
2/29/08	0.91	2/28/08	0.60
3/1/08	0.88	2/29/08	0.61
3/2/08	0.88	3/1/08	0.66
3/3/08	0.92	3/2/08	0.65
3/4/08	0.92	3/3/08	0.81
3/5/08	0.93	3/4/08	0.80
3/6/08	0.92	3/5/08	0.73
3/7/08	0.90	3/6/08	0.87
3/8/08	0.91	3/7/08	1.16
3/9/08	0.92	3/8/08	1.03
3/10/08	0.93	3/9/08	0.86
3/11/08	0.91	3/10/08	0.86
3/12/08	0.91	3/11/08	0.87
3/13/08	0.90	3/12/08	0.80
3/14/08	0.90	3/13/08	0.77
3/15/08	0.89	3/14/08	0.80
3/16/08	0.89	3/15/08	0.79

3/17/08	0.91	3/16/08	0.76
3/18/08	0.89	3/17/08	0.91
3/19/08	0.91	3/18/08	1.12
3/20/08	0.90	3/19/08	1.19
3/21/08	0.92	3/20/08	0.80
3/22/08	0.89	3/21/08	0.81
3/23/08	0.89	3/22/08	0.70
3/24/08	0.92	3/23/08	0.66
3/25/08	0.91	3/24/08	0.65
3/26/08	0.90	3/25/08	0.64
3/27/08	0.90	3/26/08	0.66
3/29/08	0.91	3/28/08	0.67
3/30/08	0.90	3/29/08	0.68
3/31/08	0.90	3/30/08	0.71
4/1/08	0.91	3/31/08	0.87
4/2/08	0.91	4/1/08	0.97
4/3/08	0.91	4/2/08	0.90
4/4/08	0.91	4/3/08	0.82
4/5/08	0.91	4/4/08	0.84
4/7/08	0.91	4/5/08	0.87
4/8/08	0.90	4/6/08	0.87
4/9/08	0.91	4/7/08	0.82
4/10/08	0.92	4/8/08	0.92
4/11/08	0.93	4/9/08	1.07
4/12/08	0.94	4/10/08	1.17
4/13/08	0.94	4/11/08	1.15
4/14/08	0.92	4/12/08	0.97
4/15/08	0.94	4/13/08	0.71
4/16/08	0.91	4/14/08	0.65
4/17/08	0.90	4/15/08	0.60
4/18/08	0.92	4/16/08	0.60
4/19/08	0.93	4/17/08	0.76
4/20/08	0.92	4/18/08	0.99
4/21/08	0.90	4/19/08	0.86
4/22/08	0.90	4/20/08	0.82
4/23/08	0.91	4/21/08	0.85
4/24/08	0.92	4/22/08	0.89
4/25/08	0.92	4/23/08	0.87
4/26/08	0.94	4/24/08	0.91
4/27/08	0.94	4/25/08	0.99
4/28/08	0.94	4/26/08	1.01
4/29/08	0.94	4/27/08	1.10

4/30/08	0.93	4/28/08	1.06
5/1/08	0.92	4/29/08	0.89
5/2/08	0.94	4/30/08	0.78
5/3/08	0.99	5/1/08	0.96
5/4/08	0.95	5/2/08	1.12
5/5/08	0.94	5/3/08	1.23
5/6/08	0.93	5/4/08	1.16
5/7/08	0.93	5/5/08	1.31
5/8/08	0.94	5/6/08	1.28
5/9/08	0.92	5/7/08	1.19
5/10/08	0.94	5/8/08	1.09
5/11/08	0.93	5/9/08	0.84
5/12/08	0.92	5/10/08	0.73
5/13/08	0.91	5/11/08	0.70
5/14/08	0.92	5/12/08	0.64
5/15/08	1.23	5/13/08	0.72
5/16/08	1.11	5/14/08	0.85
5/17/08	1.04	5/15/08	1.11
5/18/08	1.05	5/16/08	1.16
5/19/08	1.03	5/17/08	1.40
5/20/08	0.98	5/18/08	1.37
5/21/08	0.95	5/19/08	1.22
5/22/08	0.95	5/20/08	1.00
5/23/08	0.94	5/21/08	0.72
5/24/08	0.94	5/22/08	0.70
5/25/08	0.94	5/23/08	0.90
5/26/08	0.94	5/24/08	0.84
5/27/08	0.94	5/25/08	0.79
5/29/08	0.94	5/26/08	0.75
5/30/08	0.94	5/27/08	0.83
5/31/08	0.94	5/28/08	0.76
6/1/08	0.94	5/29/08	0.71
6/2/08	0.94	5/30/08	0.79
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6/8/08	0.94	6/5/08	0.73
6/9/08	0.94	6/6/08	0.81
6/10/08	0.94	6/7/08	0.81
6/11/08	0.94	6/8/08	0.77
6/12/08	0.94	6/9/08	0.73

6/13/08	0.94	6/10/08	0.72
6/14/08	0.94	6/11/08	0.69
6/15/08	0.94	6/12/08	0.80
6/16/08	0.94	6/13/08	0.80
6/17/08	0.94	6/14/08	0.75
6/18/08	0.94	6/15/08	0.81
6/19/08	0.94	6/16/08	0.75
6/20/08	0.94	6/17/08	0.69
6/21/08	0.95	6/18/08	0.69
6/22/08	0.95	6/19/08	0.78
6/25/08	0.95	6/20/08	0.77
6/26/08	0.95	6/21/08	0.73
6/27/08	0.95	6/22/08	0.71
6/28/08	0.95	6/23/08	0.69
6/29/08	0.96	6/25/08	0.69
6/30/08	0.95	6/26/08	0.73
7/1/08	0.95	6/27/08	0.86
7/2/08	0.95	6/28/08	0.82
7/3/08	0.94	6/29/08	0.75
7/4/08	0.95	6/30/08	0.68
7/5/08	0.95	7/1/08	0.68
7/6/08	0.96	7/2/08	0.77
7/7/08	0.96	7/3/08	0.77
7/8/08	0.96	7/4/08	0.71
7/11/08	0.96	7/5/08	0.70
7/12/08	0.95	7/6/08	0.84
7/13/08	0.96	7/7/08	0.75
7/14/08	0.96	7/8/08	0.79
7/15/08	0.96	7/9/08	0.85
7/24/08	0.92	7/10/08	0.78
7/25/08	0.93	7/11/08	0.75
7/26/08	0.93	7/12/08	0.68
7/27/08	0.94	7/13/08	0.65
7/28/08	0.94	7/14/08	0.59
7/29/08	0.94	7/15/08	0.65
7/30/08	0.94	7/16/08	0.65
7/31/08	0.94	7/17/08	0.68
8/1/08	0.95	7/18/08	0.75
8/2/08	0.94	7/19/08	0.76
8/3/08	0.94	7/20/08	0.73
8/4/08	0.94	7/21/08	0.71
8/5/08	0.94	7/22/08	0.77

8/6/08	0.94	7/23/08	0.77
8/7/08	0.95	7/24/08	0.75
8/8/08	0.95	7/25/08	0.71
8/9/08	0.95	7/26/08	0.68
8/10/08	0.94	7/27/08	0.68
8/11/08	0.95	7/28/08	0.68
8/12/08	0.95	7/29/08	0.69
8/13/08	0.95	7/30/08	0.69
8/14/08	0.95	7/31/08	0.71
8/15/08	0.94	8/1/08	0.71
8/16/08	0.97	8/2/08	0.69
8/17/08	0.95	8/3/08	0.68
8/18/08	0.98	8/4/08	0.95
8/19/08	0.96	8/5/08	1.03
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8/23/08	0.96	8/9/08	0.67
8/24/08	0.99	8/10/08	0.67
8/25/08	0.99	8/11/08	0.66
8/26/08	0.98	8/12/08	0.68
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8/28/08	0.98	8/14/08	0.66
8/29/08	0.97	8/15/08	0.66
8/30/08	0.99	8/16/08	0.70
8/31/08	0.98	8/17/08	0.69
9/1/08	0.98	8/18/08	0.72
9/2/08	1.12	8/19/08	0.79
9/3/08	1.36	8/20/08	0.84
9/4/08	1.42	8/21/08	0.80
9/5/08	1.34	8/22/08	0.84
9/6/08	1.28	8/23/08	0.76
9/7/08	1.20	8/24/08	0.71
9/8/08	1.15	8/25/08	0.69
9/9/08	1.08	8/26/08	0.65
9/10/08	1.05	8/27/08	0.60
9/11/08	1.06	8/28/08	0.65
9/12/08	1.18	8/29/08	0.68
9/13/08	2.00	8/30/08	0.71
9/14/08	1.77	8/31/08	0.85
9/15/08	1.54	9/1/08	1.17
9/16/08	1.36	9/2/08	1.99

9/17/08	1.24	9/3/08	1.75
9/18/08	1.13	9/4/08	1.61
9/19/08	1.06	9/5/08	1.52
9/20/08	1.02	9/6/08	1.45
9/21/08	1.04	9/7/08	1.40
9/22/08	1.03	9/8/08	1.34
9/23/08	1.01	9/9/08	1.26
9/24/08	1.01	9/10/08	1.21
9/25/08	1.01	9/11/08	1.33
9/26/08	0.98	9/12/08	1.86
9/27/08	0.98	9/13/08	2.33
9/28/08	0.97	9/14/08	1.99
9/29/08	0.96	9/15/08	1.70
9/30/08	0.96	9/16/08	1.49
10/1/08	0.97	9/17/08	1.33
10/2/08	0.96	9/18/08	1.21
10/3/08	0.96	9/19/08	1.15
10/4/08	0.96	9/20/08	1.17
10/5/08	0.98	9/21/08	1.18
10/6/08	0.96	9/22/08	1.20
10/7/08	0.97	9/23/08	1.18
10/8/08	0.98	9/24/08	1.20
10/9/08	1.00	9/25/08	1.19
10/10/08	0.98	9/26/08	1.12
10/11/08	0.98	9/27/08	1.00
10/12/08	0.98	9/28/08	0.93
10/13/08	0.98	9/29/08	0.97
10/14/08	0.99	9/30/08	1.05
10/15/08	1.00	10/1/08	0.98
10/16/08	1.01	10/2/08	0.98
10/17/08	0.99	10/3/08	0.92
10/18/08	0.99	10/4/08	0.87
10/19/08	0.97	10/5/08	0.90
10/20/08	0.98	10/6/08	1.09
10/21/08	0.98	10/7/08	1.14
10/22/08	0.97	10/8/08	1.11
10/23/08	0.98	10/9/08	0.94
10/24/08	0.98	10/10/08	0.94
10/25/08	0.97	10/11/08	0.92
10/26/08	0.95	10/12/08	1.06
10/27/08	0.91	10/13/08	1.16
10/28/08	0.92	10/14/08	1.20

10/29/08	0.93	10/15/08	1.26
10/30/08	0.93	10/16/08	1.23
10/31/08	0.93	10/17/08	1.16
11/2/08	0.93	10/18/08	1.03
11/4/08	0.93	10/19/08	1.03
11/5/08	0.94	10/20/08	1.01
11/7/08	0.94	10/21/08	0.97
11/8/08	0.94	10/22/08	0.98
11/9/08	0.94	10/23/08	1.09
11/10/08	0.96	10/24/08	1.26
11/11/08	0.97	10/25/08	1.17
11/12/08	0.96	10/26/08	0.98
11/13/08	0.97	10/27/08	0.75
11/14/08	0.96	10/28/08	0.72
11/15/08	0.98	10/29/08	0.71
11/16/08	0.96	10/30/08	0.70
11/17/08	0.96	10/31/08	0.78
11/18/08	0.96	11/1/08	0.83
11/19/08	0.96	11/2/08	0.85
11/20/08	0.94	11/3/08	0.89
11/21/08	0.94	11/4/08	0.93
11/22/08	0.96	11/5/08	0.95
11/23/08	0.95	11/6/08	0.94
11/24/08	0.96	11/7/08	0.83
11/25/08	0.97	11/8/08	0.75
11/26/08	0.93	11/9/08	0.70
11/27/08	0.96	11/10/08	0.87
11/28/08	0.93	11/11/08	1.01
11/30/08	0.93	11/12/08	1.10
12/1/08	0.93	11/13/08	1.08
12/2/08	0.93	11/14/08	1.07
12/3/08	0.93	11/15/08	0.87
12/5/08	0.93	11/16/08	0.71
12/6/08	0.93	11/17/08	0.69
12/7/08	0.93	11/18/08	0.67
12/9/08	0.93	11/19/08	0.66
12/10/08	0.93	11/20/08	0.66
12/11/08	0.96	11/21/08	0.64
12/12/08	0.92	11/22/08	0.82
12/13/08	0.93	11/23/08	0.87
12/14/08	0.94	11/24/08	0.89
12/15/08	0.95	11/25/08	0.79

12/16/08	0.95	11/26/08	0.77
12/17/08	0.97	11/27/08	0.76
12/18/08	0.93	11/28/08	0.80
12/19/08	0.93	11/29/08	0.79
12/21/08	0.93	11/30/08	0.78
12/22/08	0.93	12/1/08	0.69
12/23/08	0.93	12/2/08	0.65
12/24/08	0.93	12/3/08	0.62
12/25/08	0.93	12/4/08	0.69
12/26/08	0.94	12/5/08	0.65
12/27/08	0.96	12/6/08	0.76
12/28/08	0.95	12/7/08	0.67
12/29/08	0.94	12/8/08	0.65
12/30/08	0.93	12/9/08	0.84
12/31/08	0.93	12/10/08	0.92
		12/11/08	0.75
		12/12/08	0.70
		12/13/08	0.69
		12/14/08	0.93
		12/15/08	1.04
		12/16/08	1.01
		12/17/08	0.93
		12/18/08	0.87
		12/19/08	0.82
		12/20/08	0.73
		12/21/08	0.72
		12/22/08	0.68
		12/23/08	0.88
		12/24/08	1.01
		12/25/08	0.94
		12/26/08	0.90
		12/27/08	0.93
		12/28/08	0.89
		12/29/08	0.88
		12/30/08	0.85
		12/31/08	0.80

SUMMARY OF THE OVERALL WATER STAGE FOR ONE YEAR

Water depths were very similar between the Treatment and Control sites. Both sites had the deepest water in May and December of 2007 (Figures 2 and 3). No action is needed at this time.

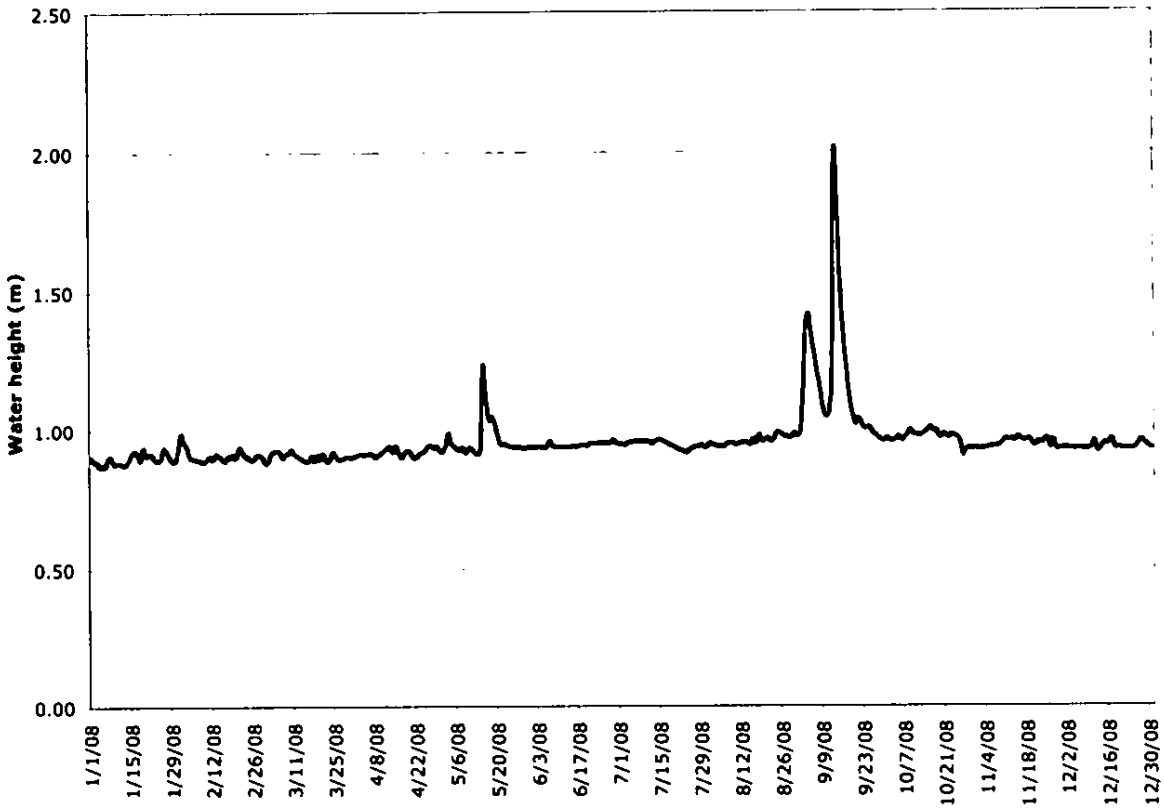

Figure 2. Water depths recorded in the Treatment site at the Hammond Assimilation Wetland in 2008.

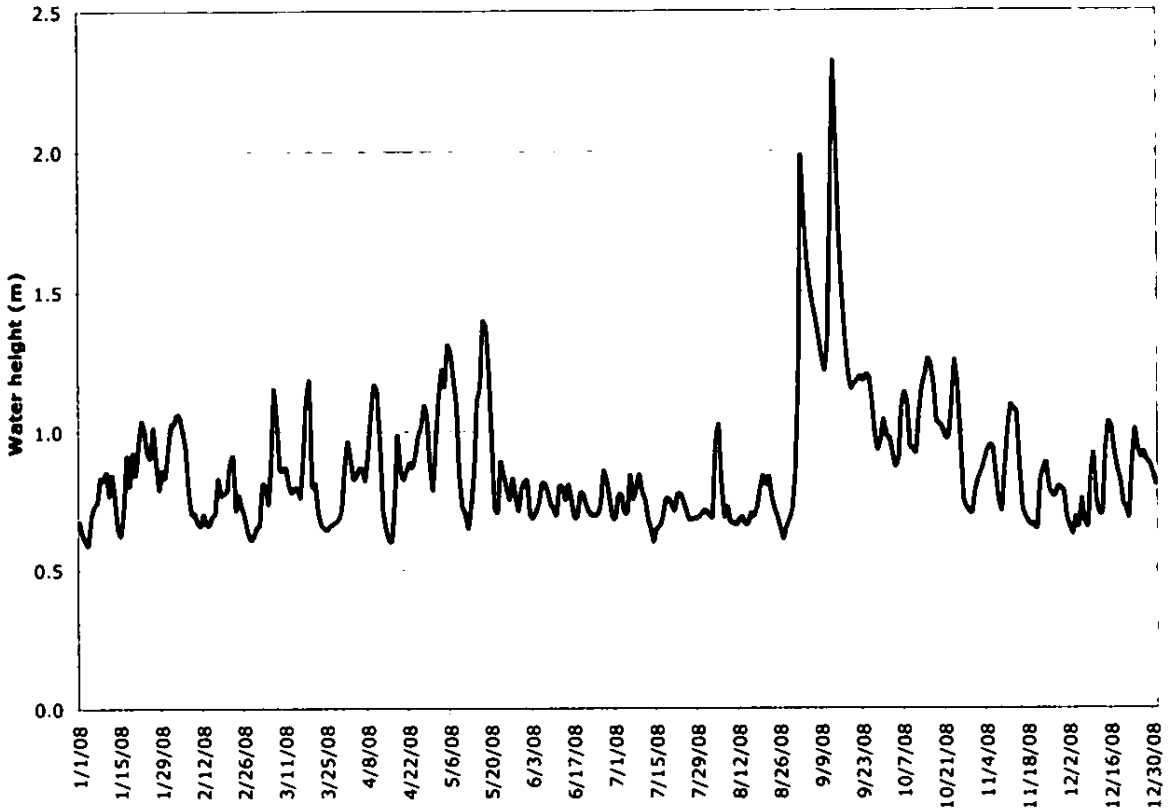

Figure 3. Water depths recorded in the Control site at the Hammond Assimilation Wetland in 2008.

Water Flow Characteristics at the Hammond Wetland Assimilation Site: July, 2009

On July 2, 2009, measurements of water flow at the Hammond site were measured using multiple dye drops. Taking part in the measurements were Drs. John Day, Gary Shaffer, and Charles Sasser, Mr. Jimmy Ernst of the Dept. of Wildlife and Fisheries, Jason Day, Bernard Wood, and Eva Hillmann.

Observations were made at all four boardwalks, in the swamp area to the east and south of the discharge pipe, at the first opening under the railroad south of South Slough, and at the Joyce Wildlife Area boardwalk (Figure 4). The treated effluent was being discharged through the eastern end of the discharge pipe. Because of this, and the recent drought, the only place in the area where there was surface water was downstream of the discharge from the distribution pipe.

There was no surface standing water at the middle and western boardwalks in the assimilation area and at the Joyce boardwalk. There was no flow under the first bridge on the railroad.

Where there was water movement, flow was measured by dropping small amounts of dye (several ml) and monitoring movement of the dye patch over roughly 10-minute periods. At the boardwalk, dye was dropped in the water and the time for the dye patch to move one meter was noted. Note how the water flow separates as it moves through the vegetation (Figure 5-7). The direction of water flow and water depth also were measured. Observations also were made for longer periods of time. Ten to twenty ml of dye was dropped in the water and observations were made for roughly 10 minutes. Estimates of the distance traveled were measured and the direction of dye movement was noted. The longer observations were made at the eastern boardwalk and from the discharge pipe. In addition, Dr. Shaffer and his students walked into the swamp to the location indicated on the photo (Figure 4) and made multiple dye drops and measured direction and velocity of flow.

Figure 4. Location of dye study and water flow at the Hammond assimilation wetland.

Water flow after leaving the discharge pipe was to the southeast (Figure 4). No flow was observed moving to the west. Water depths along the eastern boardwalk were 8-10 cm and flow velocities were 3-4 cm/sec. At the edge of cypress seedling exclosure, flow was 10 cm/sec. For the measurements in the swamp east and south of the discharge, water depths were deeper, ranging from 16 to 30 cm. Current velocities in the swamp 200 meters east of the discharge pipe were 2.08 to 3.33 cm/sec. At 500 meters southeast of the discharge pipe, current velocities were lower, ranging from 0.5 to 1.67 cm/sec. These results indicate that as the water flowed away from the discharge pipe, it spread out and slowed down. For the dye patches that were followed for 5 and 10 minutes, we estimate that water moved about 20-25 m and 30-40 m, respectively. Details of measurements are given in the table below.

These measurements represent water flow movement under extremely dry conditions with discharge from the eastern end of the discharge pipe. We plan to repeat the measurements when rainfall returns to more normal conditions and with the discharge from different locations along the discharge pipe.

Water flow velocities and water depths during the July dye study.
All flows were in a southeasterly direction.

Discription of measurement site	velocity cm/sec	Depth cm
Ditch at east end of pipeline	0.10	22
200 meters east of pipeline, Ten meters of edge in marsh	3.33	16
200 meters east of pipeline, Ten meters of edge in marsh	2.50	16
200 meters east of pipeline, Ten meters of edge in marsh	2.08	16
300 meters east of pipeline,15 meters off edge in marsh	0.33	20
500 meters east of pipeline, 5 meters off edge in swamp	1.67	20
500 meters east of pipeline, 5 meters off edge in swamp	0.83	20
500 meters east of pipeline, 5 meters off edge in swamp	0.50	20
500 meters east of pipeline, 100 meters off edge in swamp	0.50	30
500 meters east of pipeline, 400 meters off edge in swamp	1.67	30
500 meters east of pipeline, 400 meters off edge in swamp	1.50	30
500 meters east of pipeline, 400 meters off edge at swamp marsh interface	0.55	30

500 meters east of pipeline, 300 meters off edge interior swamp	0.87	30
East boardwalk, 10 m, at edge of exclosure	10.00	10
East boardwalk, 20 m	3.70	10
East boardwalk, 30 m	4.00	8
East boardwalk, 40 m	3.13	10
East boardwalk, 50 m	3.33	9

Figure 5. Dropping dye into the water at the Hammond assimilation wetland.

Figure 6. Movement of tracer dye through the water at the Hammond assimilation wetland.

Figure 7. Movement of tracer dye through the water at the Hammond assimilation wetland. Note how dye moves around vegetation.

NUTRIENT ANALYSIS I (Surface Water)

Surface water samples were collected quarterly and taken to an EPA-approved laboratory for analysis.

PARAMETER	NUTRIENT ANALYSIS I (Surface Water)											
	Wastewater Treatment Area							Control Area				
	UAA Average (mg/L)			Current Average (mg/L)			Difference[1]	UAA Average (mg/L)		Current Average (mg/L)		Difference[1]	ANOVA Significant Difference[2] (p=0.05) YES or NO
	Treatment Area (mean ± standard error)			Treatment Area (mean ± standard error)				Control Area (mean ± standard error)		Control Area (mean ± standard error)			
	TMT	MID	OUT	TMT	MID	OUT		FC[3]	MC[4]	FC	MC		
Total Kjeldahl Nitrogen (TKN)	ND[5]	ND	ND	7.26± 4.40	3.24± 1.56	1.00± 0.29	ND	ND	ND	0.58± 0.22	0.86± 0.16	ND	FC = N MC = N,N
Total Phosphorus (TP)	0.46± 0.38	0.11± 0.04	0.11± 0.02	2.50± 0.39	1.44± 0.87	0.07± 0.03	1,0,0	0.60± 0.49	0.39± 0.29	0.13± 0.03	0.06± 0.02	0,0	FC = N MC = Y,N

[1] The difference in the UAA value and the current value shall be indicated by **NO INCREASE=0**, **INCREASE=1**, and **DECREASE=2**.
[2] Analysis of Variance (ANOVA), a significant difference (p=0.05) between the wastewater treatment area and the control area shall be indicated by YES or NO.
[3] Forested Control.
[4] Marsh Control.
[5] Not determined because no data were available.

NUTRIENT ANALYSIS I (Surface Water) continued:

ANALYSIS OF VARIANCE (ANOVA):

Has there been a significant difference (p=0.05) between the Nutrient Analysis I (Surface Water) in the control and the treatment area?

As indicated in the table as YES or NO .

If yes, please explain the significant differences between the control and the treatment areas and outline any corrective actions taken, if needed.

Total Kjeldahl Nitrogen (TKN) was not measured during the UAA study and, therefore, could not be compared to current concentrations. There were no differences in mean TKN concentrations measured among the March Control, Out or Treatment sites (P = 0.1835). No differences were measured in mean TKN concentrations between the Forested Control and the Mid sites (P = 0.1016).

Mean concentration of Total Phosphorus (TP) was higher in the Treatment site in 2008 than in the pre-discharge period, but no differences were observed for the Marsh Control or Out sites. Mean TP measured in 2008 was significantly higher in the Treatment site than in the Marsh Control or Out sites. It is expected that nutrient concentrations will be higher in the Treatment site than in the other sites because that is where the treated effluent is discharged. However, because no differences were observed between mean TP measured in the Marsh Control and Out sites, this shows that the wetland is able to effectively assimilate the added phosphorus. No differences were measured in mean TP concentrations between the Forested Control and the Mid sites (P = 0.1316).

NUTRIENT ANALYSIS II (Surface Water)

PARAMETER	NUTRIENT ANALYSIS II (Surface Water)											
	Wastewater Treatment Area							Control Area					ANOVA Significant Difference[2] (p=0.05) YES or NO
	UAA Average (mg/L)			Current Average (mg/L)			Difference[1]	UAA Average (mg/L)		Current Average (mg/L)		Difference[1]	
	Treatment Area (mean ± standard error)			Treatment Area (mean ± standard error)				Control Area (mean ± standard error)		Control Area (mean ± standard error)			
	TMT	MID	OUT	TMT	MID	OUT		FC[3]	MC[4]	FC	MC		
Ammonium (NH_4-N)	0.03± 0.02	0.01± 0.005	0.03± 0.01	5.79± 2.99	0.40± 0.38	0.03± 0.01	1,0,0	0.05± 0.03	0.03± 0.01	0.03± 0.01	0.03±0.01	0,0	FC = N MC = N,N
Nitrate+Nitrite Nitrogen (NO_3+NO_2-N)	BDL[5]	0.05± 0.02	BDL	1.94± 1.20	0.16± 0.11	0.10± 0.03	0,0,0	BDL	BDL	0.11± 0.03	0.09±0.03	0,0	FC = N MC = N,N
Phosphate (PO_4-P)	ND[5]	ND	ND	2.23± 0.53	1.25± 0.78	0.01± 0.01	ND	ND	ND	0.04± 0.02	0.01±0.01	ND	FC = N MC = Y,N

[1] The difference in the UAA value and the current value shall be indicated by **NO INCREASE=0, INCREASE=1, DECREASE=2.**
[2] Analysis of Variance (ANOVA), a significant difference (p=0.05) between the wastewater treatment area and the control area shall be indicated by YES or NO.
[3] Forested Control.
[4] Marsh Control.
[5] Below detection limit.
[6] Not determined.

NUTRIENT ANALYSIS II (Surface Water) continued:

ANALYSIS OF VARIANCE (ANOVA):

Has there been a significant difference (p=0.05) between the Nutrient Analysis II (Surface Water) in the control and the treatment area?

As indicated in the table as YES or NO.

If yes, please explain the significant differences between the control and the treatment areas and outline any corrective actions taken, if needed.

Mean ammonium concentration measured in 2008 was higher in the Treatment site than concentration measured in the pre-discharge period, but no differences were seen in the Mid, Out, Swamp Control, or Marsh Control sites. No differences were detected between mean ammonium concentrations in the Mid and Forested Control sites (P = 0.2945) or between concentrations measured among the Treatment, Out, and Marsh Control sites (P = 0.0670).

No differences were measured between mean nitrate+nitrite concentrations measured in 2008 and the pre-discharge period for any of the sites. No differences were detected between mean nitrate+nitrite concentrations in the Mid and Forested Control sites (P = 0.6098) or between concentrations measured among the Treatment, Out, and Marsh Control sites (P = 0.1481).

No differences were detected between mean ortho-phosphate concentrations in the Mid and Forested Control sites (P = 0.1316). Mean ortho-phosphate concentration was significantly higher in the Treatment site than in the Out or Marsh Control sites (P = 0.0008).

PHYSICAL WATER PARAMETERS

Dissolved oxygen (DO), conductivity, temperature, salinity, and pH were measured in surface water at each site. Data are missing for some sites because no surface water was present or because surface water was not deep enough to use the YSI meter or the site was dry.

PARAMETER	PHYSICAL WATER PARAMETERS											
	Wastewater Treatment Area							Control Area				
	UAA Average (mg/L)			Current Average (mg/L)			Difference[1]	UAA Average (mg/L)		Current Average (mg/L)		Difference[1]	ANOVA Significant Difference[2] (p=0.05) YES or NO
	Treatment Area (mean ± standard error)			Treatment Area (mean ± standard error)				Control Area (mean ± standard error)		Control Area (mean ± standard error)			
	TMT	MID	OUT	TMT	MID	OUT		FC[3]	MC[4]	FC	MC		
Dissolved Oxygen	0.55± 0.40	0.81± 0.21	2.84± 1.33	0.98± 0.37	2.40± 0.56	3.42± 0.93	0,0,0	3.92± 1.86	3.70± 2.04	2.52± 0.90	2.27± 0.43	0,0	FC = N MC =
Temp	22.60± 6.06	17.70± 6.13	20.06± 7.43	24.09± 2.17	22.16± 2.56	24.66± 2.03	0,0,0	19.22± 6.51	27.30± 4.10	23.47± 1.51	23.87± 2.36	0,0	FC = N MC =
Salinity	0.30± 0.26	0.23± 0.21	0.38± 0.25	0.29± 0.03	0.30± 0.10	1.13± 0.47	0,0,0	0.14± 0.09	0.35± 0.49	0.44± 0.22	1.00± 0.53	0,0	FC = N MC =
pH	5.43± 0.00	5.62± 0.03	6.15± 0.45	7.11± 0.28	7.12± 0.20	6.82± 0.24	0,0,0	5.94± 0.17	6.08± 0.23	6.67± 0.25	6.64± 0.21	0,0	FC = N MC =
TSS	ND[5]	ND	ND	11.25± 5.62	18.67± 8.64	9.75± 3.97	ND	ND	ND	6.65± 1.03	12.25± 4.48	ND	FC = N MC = N,N

[1]The difference in the UAA value and the current value shall be indicated by NO INCREASE=0, INCREASE=1, DECREASE=2.
[2]Analysis of Variance (ANOVA), a significant difference (p=0.05) between the wastewater treatment area and the control area shall be indicated by YES or NO.
[3]Forested Control.
[4]Marsh Control.
[5]Not determined.

PHYSICAL WATER PARAMETERS continued:

ANALYSIS OF VARIANCE (ANOVA):

Has there been a significant difference (p=0.05) between the Nutrient Analysis II (Surface Water) in the control and the treatment area?

As indicated in the table as YES or NO.

If yes, please explain the significant differences between the control and the treatment areas and outline any corrective actions taken, if needed.

No differences were measured between 2008 values and those measured prior to discharge for any of the parameters.

No differences were measured in mean dissolved oxygen (DO) concentration among the Mid and Forested Control sites (P = 0.9109) but mean DO measured in the Treatment site was significantly lower than that measured in the Out site (P = 0.0433).

No differences were measured in mean temperature among the Mid and Forested Control sites (P = 0.6665) and no differences were measured among the Treatment, Out, and Marsh Control sites (P = 0.9663).

No differences were measured in mean salinity among the Mid and Forested Control sites (P = 0.5660) and no differences were measured among the Treatment, Out, and Marsh Control sites (P = 0.3161).

No differences were measured in mean pH among the Mid and Forested Control sites (P = 0.1913) and no differences were measured among the Treatment, Out, and Marsh Control sites (P = 0.3940).

No differences were measured in mean Total Suspended Solids (TSS) concentration among the Mid and Forested Control sites (P = 0.1624) and no differences were measured among the Treatment, Out, and Marsh Control sites (P = 0.9324).

ISSUES AND CONCERNS

Nutria overgrazing is a problem in wetlands in Louisiana. The Coastwide Nutria Control Program estimates that about 100,000 acres of wetlands are presently impacted by nutria. Without sustained reduction of nutria populations, wetland restoration efforts will be significantly hampered. Federal funding was provided for a nutria control program within Louisiana and the program was implemented by the Louisiana Department of Wildlife and Fisheries. The program pays trappers up to $4 per nutria harvested. We recommend that active nutria harvesting be implemented within the Hammond assimilation wetland and nearby control wetland to reduce the nutria population.

11643 Pride Port Hudson Rd.
Zachary, LA 70791
225-654-8847
225-658-0029 fax

Comite Resources, Inc.

Louisiana Department of Environmental Quality
Office of Environmental Services
Permits Division
Municipal and General Water Permits Section
P.O. Box 4313
Baton Rouge, LA 70821-4313

August 31, 2009

Re: Hammond Wetland Assimilation Monitoring Annual Report 2008-2009

Dear Sir:,

The purpose of this letter is to submit Hammond's Wetland Assimilation Monitoring Annual report. If you have any questions please telephone 225-654-8847 or e-mail lindseyj@bellsouth.net.

Sincerely,

Joel Lindsey
Principal

Cc: Office of Environmental Compliance
Enforcement Division Attention: Permit Compliance Unit

Louisiana Department of Environmental Quality
Office of Environmental Assessment
Water Quality Division
% Kris Pintado

LOUISIANA POLLUTANT DISCHARGE ELIMINATION SYSTEM (LPDES)

Wetland System Monitoring Requirement

for

City of Hammond
Wetland Assimilation Project

Comite Resources, Inc.

2008 Annual Wetland Monitoring Report

Date: August 31, 2009

ANNUAL WETLAND MONITORING REPORT
Summary Sheet

City of Hammond
310 East Charles St.
Hammond, Louisiana 70404-2788

Permit Number: LA0032328
Agency Interest Number: AI19578

The city of Hammond is located in eastern Louisiana in Tangipahoa Parish, 58 miles north of New Orleans, and 45 miles east of Baton Rouge. The South Slough wetlands are located approximately seven miles southeast of Hammond, and are bordered to the north by South Slough canal, to the west by Highway 51 and I-55, and to the east and south by the Joyce Wildlife Management Area (JWMA). A wastewater distribution system running east-west on the south side of the spoil bank along South Slough disperses effluent evenly along the northern edge of the wetlands. Wastewater is prevented from entering South Slough canal. The JWMA, south of the wetland discharge site, receives water after passing through the South Slough wetlands. The JWMA is bordered to the north by uplands, to the west by Highway 51 and I-55, to the south by Pass Manchac, and to the east by Lake Pontchartrain and the Tangipahoa River.

Hammond's treatment system has a design capacity of 8 million gallons per day (MGD). Influent wastewater is collected and passed through the South WWTP headworks and then piped to a three-cell oxidation lagoon located on the north side of C. M. Fagan Drive. After this, effluent is disinfected prior to transportation via force main. Dechlorination occurs near the City of Ponchatoula's wastewater treatment plant prior to discharge directly into South Slough wetlands; thence into the Joyce Wildlife Management Area Wetlands; thence into Lake Pontchartrain.

The outfall distribution system is comprised of 3,600 LF of aerial piping laid out from west to east. The distribution system is constructed on pilings along the south bank of South Slough. Treated sanitary effluent is discharge directly into South Slough Wetlands; thence into the Joyce Wildlife Management Area Wetlands; thence into Lake Pontchartrain.

In order to effectively monitor the effect of this discharge on the floral and faunal components in the receiving wetlands, several study locations were identified and delineated. The region

surrounding the wastewater distribution system was designated as the Treatment Site (Figure 1). The region where effluent will pass out of the Joyce Wildlife Management Area into Middle Bayou was designated as the OUT Site. Both the Treatment and OUT sites contain herbaceous vegetation. A study site was also established in the forested wetlands south of the treatment site, designated as MID Site. Two control sites, one forested and one marsh, were also established in hydrologically isolated but ecologically similar wetlands located nearby (Figure 1). The forested wetland control site, referred to as Forested Control in this document, is located just west of Black Bayou. The marsh control site, referred to as Marsh Control in this document, is located near the southeastern corner of the JWMA. Establishment of study sites, installation of equipment, and monitoring at the Hammond wetland assimilation project by Comite Resources, Inc. began in the late spring/summer of 2006.

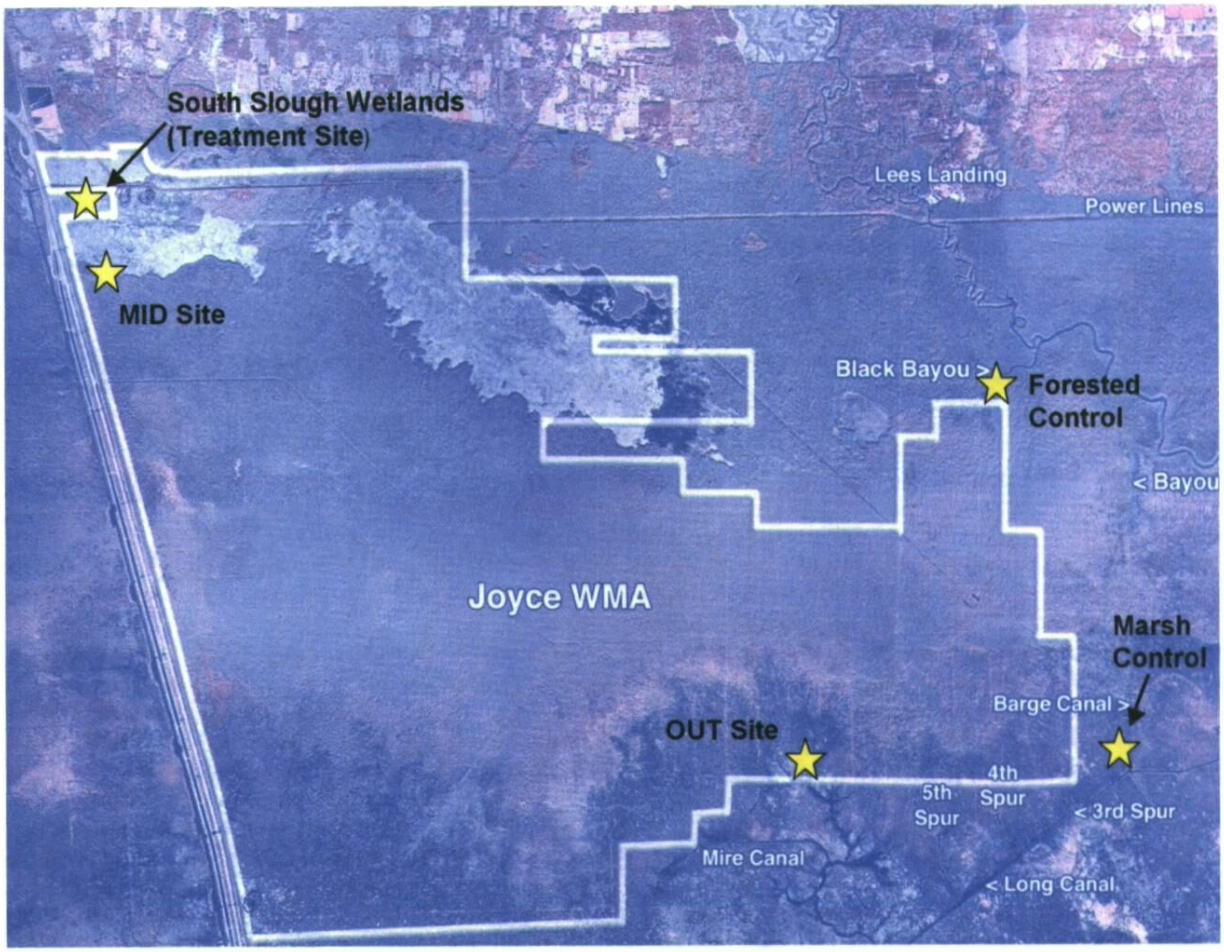

Figure 1. Map showing the Hammond assimilation wetland study site locations.

GROWTH STUDIES ~ STEM GROWTH (Flora)

Plots for measuring perennial productivity were established in the MID and Forested Control sites. At each site, three 10 x 33-m plots were designated. Within each plot, trees > 2.5 cm in diameter at breast height (DBH) were tagged. To estimate biomass, DBH was measured initially when trees were dormant and then re-measured again one year later. Biomass for each species was estimated by applying recorded DBH measurements to published regression equations. Change in biomass represents annual stem production and, when added to annual leaf litterfall, provides an estimation of aboveground net primary production in each forested plot.

PARAMETER	GROWTH STUDIES ~ STEM GROWTH (Flora)					
	Wastewater Management Area (g/m²/yr) (mean ± standard error)			Control Area (g/m²/yr) (mean ± standard error)		
	UAA Overall Average	Current Overall Average	Difference[1]	UAA Overall Average	Current Overall Average	Difference[1]
Tmt Area 2 (MID)	509.4±31.6	199.2±47.4	2			
Forested Control				245.4±29.2	117.6±30.2	2

[1] The difference in the UAA value and the Current value shall be indicated by **NO INCREASE = 0, INCREASE = 1, or DECREASE = 2.**

ANALYSIS OF VARIANCE (ANOVA)

Was there a significant difference (p=0.05) between stem growth (flora) in the control and the treatment area?

☐ YES ✓ NO

If yes, please explain the significance between the control and the treatment areas and outline any corrective actions taken, if needed.

There was no significant difference detected among stem growth in the Mid and the Forested Control sites (P = 0.2203). Stem growth measured in 2008 was lower than in the pre-discharge period in both the Mid and Control sites. Because a decrease in productivity was observed in both the Mid and Control sites, it is assumed to be due to environmental factors and not due to treated effluent.

GROWTH STUDIES ~ LITTER FALL (Flora)

Two 10 x 100 m quadrates, divided into three 10 x 33.3 m subplots, were established at the Mid and Forested Control sites. Two 0.25 m^2 leaf litter boxes, with screened bottoms and approximately 10 cm wide sides, were placed randomly in each subplot. Leaves and other materials collected in the boxes were gathered monthly. The term 'leaf litter' is used in reference to all non-woody litter including flowers, fruits, and seeds that typically account for < 10% of the non-woody litterfall total. Large stems and sticks were removed from the litter, and the cleaned litter was dried to constant mass at 65°C and weighed.

PARAMETER	GROWTH STUDIES ~ LITTER FALL (Flora)					
	Wastewater Management Area (g/m²/yr) (mean ± standard error)			Control Area (g/m²/yr) (mean ± standard error)		
	UAA Total Dry Weight	Current Total Dry Weight	Difference[1]	UAA Total Dry Weight	Current Total Dry Weight	Difference[1]
Tmt Area 2 (MID)	781.5±62.0	467.4±51.0	2			
Forested Control				578.6±65.6	243.9±18.2	2

[1] The difference in the UAA value and the Current value shall be indicated by **NO INCREASE = 0, INCREASE = 1, or DECREASE = 2.**

ANALYSIS OF VARIANCE (ANOVA)

Has there been a significant difference (p=0.05) between the Litter Fall (Flora) in the control and the treatment area?

✓ YES ☐ NO

If yes, please explain the significance between the control and the treatment areas and outline any corrective actions taken, if needed.

Mean annual leaf litter was significantly higher in the Mid site than in the Control site (P = 0.0020). Litterfall and stem growth are added together to calculate net primary productivity (NPP). NPP is affected by nutrient availability and the Mid site is receiving nutrients from the discharge of treated effluent. Mean leaf litter is lower in both the Mid and Control sites in 2008 than in the pre-discharge period. Because productivity declined in the Control as well as the site receiving discharge of treated effluent, this response is most likely due to an environmental factor (e.g., decline in rainfall, etc) rather than the effluent itself.

GROWTH STUDIES ~ Marsh Productivity

At each non-forested marsh study site, end of season live (EOSL) biomass was measured using five randomly placed 0.25 m^2 quadrats. Clip plot samples were collected 10 to 20 m from the bayou edge in an area of relatively homogenous herbaceous vegetation. Vegetation within the quadrat was cut as close to the marsh surface as possible, stored in labeled paper bags, brought back to the laboratory, and refrigerated until processed. Live material was separated from dead, and dried at 60°C to a constant weight. All data are presented as live dry weight per square meter basis (g dry wt m^{-2}), and is representative of aboveground net primary productivity (NPP).

PARAMETER	GROWTH STUDIES ~ Marsh Productivity					
	Wastewater Management Area (g/m²/yr) (mean ± standard error)			Control Area (g/m²/yr) (mean ± standard error)		
	UAA Total Dry Weight	Current Total Dry Weight	Difference[1]	UAA Total Dry Weight	Current Total Dry Weight	Difference[1]
Tmt Area 1 (TMT)	1410.0±214.9	604.8±37.8	2			
Tmt Area 2 (OUT)	1399.8±215.1	1247.4±173.2	0			
Marsh Control				759.9±125.3	718.2±37.8	0

[1] The difference in the UAA value and the Current value shall be indicated by **NO INCREASE = 0, INCREASE = 1, or DECREASE = 2.**

ANALYSIS OF VARIANCE (ANOVA)

Has there been a significant difference (p=0.05) between the productivity (Flora) in the control and the treatment area?

✓ YES ☐ NO

If yes, please explain the significance between the control and the treatment areas and outline any corrective actions taken, if needed.

Mean productivity in the Out site was significantly higher than productivity in the Control or Treatment sites (0.0104). In addition, mean productivity was lower in the Treatment site in 2008 than in the pre-discharge period, but no difference was observed in the Out or Control sites. Productivity at the Treatment site decreased dramatically in 2007 due to the impact of heavy nutria grazing and low rainfall and this pattern was observed at the Out and Marsh Control sites as well.

Marsh standing crop was significantly higher in spring 2007, the first growing season of discharge. After spring 2007, there was a population explosion of nutria which grazed heavily

on the marsh. Most marsh out to 500 m from the discharge pipe was consumed by nutria in 2007. Hydrocotyl became the dominant species in the area, though it was found in low abundance prior to the nutria population explosion. Cutgrass has not been impacted by nutria. Exclosures have dense growth in them confirming that nutria are the cause of the impact on the marsh. Southeastern's Wetland Restoration Lab obtained a night-shoot permit to eliminate nutria at the Hammond site and over 2000 nutria have been killed. Since then, the marsh seems to be recovering.

WATER STAGES (Surface Water)

Water level recorders that were placed in the Treatment and Control sites were destroyed during Hurricane Katrina in 2006. The water level recorders were replaced in October 2007. Summary data are shown in the table below and in Figures 2 and 3.

Treatment		Control	
Water height (m)	Sample Date	Water height (m)	Sample Date
1/1/08	0.91	1/1/08	0.68
1/2/08	0.89	1/2/08	0.63
1/3/08	0.89	1/3/08	0.60
1/4/08	0.87	1/4/08	0.59
1/5/08	0.88	1/5/08	0.69
1/6/08	0.87	1/6/08	0.73
1/7/08	0.90	1/7/08	0.74
1/8/08	0.91	1/8/08	0.84
1/9/08	0.88	1/9/08	0.82
1/10/08	0.88	1/10/08	0.86
1/11/08	0.88	1/11/08	0.76
1/12/08	0.88	1/12/08	0.85
1/13/08	0.88	1/13/08	0.76
1/14/08	0.89	1/14/08	0.65
1/15/08	0.91	1/15/08	0.62
1/16/08	0.93	1/16/08	0.71
1/17/08	0.92	1/17/08	0.92
1/18/08	0.89	1/18/08	0.80
1/19/08	0.94	1/19/08	0.93
1/20/08	0.91	1/20/08	0.84
1/21/08	0.91	1/21/08	0.96
1/22/08	0.91	1/22/08	1.04
1/23/08	0.90	1/23/08	1.01
1/24/08	0.89	1/24/08	0.92
1/25/08	0.90	1/25/08	0.90
1/26/08	0.94	1/26/08	1.02
1/27/08	0.93	1/27/08	0.89
1/28/08	0.91	1/28/08	0.78
1/29/08	0.89	1/29/08	0.86
1/30/08	0.89	1/30/08	0.83
1/31/08	0.92	1/31/08	0.93
2/1/08	0.99	2/1/08	1.03
2/2/08	0.96	2/2/08	1.02

2/3/08	0.94	2/3/08	1.06
2/4/08	0.91	2/4/08	1.06
2/5/08	0.90	2/5/08	1.00
2/6/08	0.90	2/6/08	0.94
2/7/08	0.90	2/7/08	0.78
2/8/08	0.89	2/8/08	0.70
2/9/08	0.89	2/9/08	0.71
2/10/08	0.90	2/10/08	0.67
2/11/08	0.91	2/11/08	0.66
2/12/08	0.90	2/12/08	0.70
2/13/08	0.91	2/13/08	0.66
2/14/08	0.91	2/14/08	0.66
2/16/08	0.89	2/15/08	0.69
2/17/08	0.91	2/16/08	0.70
2/18/08	0.90	2/17/08	0.83
2/19/08	0.91	2/18/08	0.77
2/20/08	0.90	2/19/08	0.77
2/21/08	0.94	2/20/08	0.78
2/22/08	0.93	2/21/08	0.89
2/23/08	0.91	2/22/08	0.92
2/24/08	0.91	2/23/08	0.71
2/25/08	0.90	2/24/08	0.77
2/26/08	0.90	2/25/08	0.73
2/27/08	0.91	2/26/08	0.69
2/28/08	0.91	2/27/08	0.64
2/29/08	0.91	2/28/08	0.60
3/1/08	0.88	2/29/08	0.61
3/2/08	0.88	3/1/08	0.66
3/3/08	0.92	3/2/08	0.65
3/4/08	0.92	3/3/08	0.81
3/5/08	0.93	3/4/08	0.80
3/6/08	0.92	3/5/08	0.73
3/7/08	0.90	3/6/08	0.87
3/8/08	0.91	3/7/08	1.16
3/9/08	0.92	3/8/08	1.03
3/10/08	0.93	3/9/08	0.86
3/11/08	0.91	3/10/08	0.86
3/12/08	0.91	3/11/08	0.87
3/13/08	0.90	3/12/08	0.80
3/14/08	0.90	3/13/08	0.77
3/15/08	0.89	3/14/08	0.80
3/16/08	0.89	3/15/08	0.79

3/17/08	0.91	3/16/08	0.76
3/18/08	0.89	3/17/08	0.91
3/19/08	0.91	3/18/08	1.12
3/20/08	0.90	3/19/08	1.19
3/21/08	0.92	3/20/08	0.80
3/22/08	0.89	3/21/08	0.81
3/23/08	0.89	3/22/08	0.70
3/24/08	0.92	3/23/08	0.66
3/25/08	0.91	3/24/08	0.65
3/26/08	0.90	3/25/08	0.64
3/27/08	0.90	3/26/08	0.66
3/29/08	0.91	3/28/08	0.67
3/30/08	0.90	3/29/08	0.68
3/31/08	0.90	3/30/08	0.71
4/1/08	0.91	3/31/08	0.87
4/2/08	0.91	4/1/08	0.97
4/3/08	0.91	4/2/08	0.90
4/4/08	0.91	4/3/08	0.82
4/5/08	0.91	4/4/08	0.84
4/7/08	0.91	4/5/08	0.87
4/8/08	0.90	4/6/08	0.87
4/9/08	0.91	4/7/08	0.82
4/10/08	0.92	4/8/08	0.92
4/11/08	0.93	4/9/08	1.07
4/12/08	0.94	4/10/08	1.17
4/13/08	0.94	4/11/08	1.15
4/14/08	0.92	4/12/08	0.97
4/15/08	0.94	4/13/08	0.71
4/16/08	0.91	4/14/08	0.65
4/17/08	0.90	4/15/08	0.60
4/18/08	0.92	4/16/08	0.60
4/19/08	0.93	4/17/08	0.76
4/20/08	0.92	4/18/08	0.99
4/21/08	0.90	4/19/08	0.86
4/22/08	0.90	4/20/08	0.82
4/23/08	0.91	4/21/08	0.85
4/24/08	0.92	4/22/08	0.89
4/25/08	0.92	4/23/08	0.87
4/26/08	0.94	4/24/08	0.91
4/27/08	0.94	4/25/08	0.99
4/28/08	0.94	4/26/08	1.01
4/29/08	0.94	4/27/08	1.10

4/30/08	0.93	4/28/08	1.06
5/1/08	0.92	4/29/08	0.89
5/2/08	0.94	4/30/08	0.78
5/3/08	0.99	5/1/08	0.96
5/4/08	0.95	5/2/08	1.12
5/5/08	0.94	5/3/08	1.23
5/6/08	0.93	5/4/08	1.16
5/7/08	0.93	5/5/08	1.31
5/8/08	0.94	5/6/08	1.28
5/9/08	0.92	5/7/08	1.19
5/10/08	0.94	5/8/08	1.09
5/11/08	0.93	5/9/08	0.84
5/12/08	0.92	5/10/08	0.73
5/13/08	0.91	5/11/08	0.70
5/14/08	0.92	5/12/08	0.64
5/15/08	1.23	5/13/08	0.72
5/16/08	1.11	5/14/08	0.85
5/17/08	1.04	5/15/08	1.11
5/18/08	1.05	5/16/08	1.16
5/19/08	1.03	5/17/08	1.40
5/20/08	0.98	5/18/08	1.37
5/21/08	0.95	5/19/08	1.22
5/22/08	0.95	5/20/08	1.00
5/23/08	0.94	5/21/08	0.72
5/24/08	0.94	5/22/08	0.70
5/25/08	0.94	5/23/08	0.90
5/26/08	0.94	5/24/08	0.84
5/27/08	0.94	5/25/08	0.79
5/29/08	0.94	5/26/08	0.75
5/30/08	0.94	5/27/08	0.83
5/31/08	0.94	5/28/08	0.76
6/1/08	0.94	5/29/08	0.71
6/2/08	0.94	5/30/08	0.79
6/4/08	0.94	5/31/08	0.81
6/5/08	0.94	6/1/08	0.83
6/6/08	0.94	6/2/08	0.69
6/7/08	0.96	6/3/08	0.68
6/8/08	0.94	6/5/08	0.73
6/9/08	0.94	6/6/08	0.81
6/10/08	0.94	6/7/08	0.81
6/11/08	0.94	6/8/08	0.77
6/12/08	0.94	6/9/08	0.73

6/13/08	0.94	6/10/08	0.72
6/14/08	0.94	6/11/08	0.69
6/15/08	0.94	6/12/08	0.80
6/16/08	0.94	6/13/08	0.80
6/17/08	0.94	6/14/08	0.75
6/18/08	0.94	6/15/08	0.81
6/19/08	0.94	6/16/08	0.75
6/20/08	0.94	6/17/08	0.69
6/21/08	0.95	6/18/08	0.69
6/22/08	0.95	6/19/08	0.78
6/25/08	0.95	6/20/08	0.77
6/26/08	0.95	6/21/08	0.73
6/27/08	0.95	6/22/08	0.71
6/28/08	0.95	6/23/08	0.69
6/29/08	0.96	6/25/08	0.69
6/30/08	0.95	6/26/08	0.73
7/1/08	0.95	6/27/08	0.86
7/2/08	0.95	6/28/08	0.82
7/3/08	0.94	6/29/08	0.75
7/4/08	0.95	6/30/08	0.68
7/5/08	0.95	7/1/08	0.68
7/6/08	0.96	7/2/08	0.77
7/7/08	0.96	7/3/08	0.77
7/8/08	0.96	7/4/08	0.71
7/11/08	0.96	7/5/08	0.70
7/12/08	0.95	7/6/08	0.84
7/13/08	0.96	7/7/08	0.75
7/14/08	0.96	7/8/08	0.79
7/15/08	0.96	7/9/08	0.85
7/24/08	0.92	7/10/08	0.78
7/25/08	0.93	7/11/08	0.75
7/26/08	0.93	7/12/08	0.68
7/27/08	0.94	7/13/08	0.65
7/28/08	0.94	7/14/08	0.59
7/29/08	0.94	7/15/08	0.65
7/30/08	0.94	7/16/08	0.65
7/31/08	0.94	7/17/08	0.68
8/1/08	0.95	7/18/08	0.75
8/2/08	0.94	7/19/08	0.76
8/3/08	0.94	7/20/08	0.73
8/4/08	0.94	7/21/08	0.71
8/5/08	0.94	7/22/08	0.77

8/6/08	0.94	7/23/08	0.77
8/7/08	0.95	7/24/08	0.75
8/8/08	0.95	7/25/08	0.71
8/9/08	0.95	7/26/08	0.68
8/10/08	0.94	7/27/08	0.68
8/11/08	0.95	7/28/08	0.68
8/12/08	0.95	7/29/08	0.69
8/13/08	0.95	7/30/08	0.69
8/14/08	0.95	7/31/08	0.71
8/15/08	0.94	8/1/08	0.71
8/16/08	0.97	8/2/08	0.69
8/17/08	0.95	8/3/08	0.68
8/18/08	0.98	8/4/08	0.95
8/19/08	0.96	8/5/08	1.03
8/20/08	0.96	8/6/08	0.81
8/21/08	0.97	8/7/08	0.69
8/22/08	0.96	8/8/08	0.73
8/23/08	0.96	8/9/08	0.67
8/24/08	0.99	8/10/08	0.67
8/25/08	0.99	8/11/08	0.66
8/26/08	0.98	8/12/08	0.68
8/27/08	0.97	8/13/08	0.69
8/28/08	0.98	8/14/08	0.66
8/29/08	0.97	8/15/08	0.66
8/30/08	0.99	8/16/08	0.70
8/31/08	0.98	8/17/08	0.69
9/1/08	0.98	8/18/08	0.72
9/2/08	1.12	8/19/08	0.79
9/3/08	1.36	8/20/08	0.84
9/4/08	1.42	8/21/08	0.80
9/5/08	1.34	8/22/08	0.84
9/6/08	1.28	8/23/08	0.76
9/7/08	1.20	8/24/08	0.71
9/8/08	1.15	8/25/08	0.69
9/9/08	1.08	8/26/08	0.65
9/10/08	1.05	8/27/08	0.60
9/11/08	1.06	8/28/08	0.65
9/12/08	1.18	8/29/08	0.68
9/13/08	2.00	8/30/08	0.71
9/14/08	1.77	8/31/08	0.85
9/15/08	1.54	9/1/08	1.17
9/16/08	1.36	9/2/08	1.99

9/17/08	1.24	9/3/08	1.75
9/18/08	1.13	9/4/08	1.61
9/19/08	1.06	9/5/08	1.52
9/20/08	1.02	9/6/08	1.45
9/21/08	1.04	9/7/08	1.40
9/22/08	1.03	9/8/08	1.34
9/23/08	1.01	9/9/08	1.26
9/24/08	1.01	9/10/08	1.21
9/25/08	1.01	9/11/08	1.33
9/26/08	0.98	9/12/08	1.86
9/27/08	0.98	9/13/08	2.33
9/28/08	0.97	9/14/08	1.99
9/29/08	0.96	9/15/08	1.70
9/30/08	0.96	9/16/08	1.49
10/1/08	0.97	9/17/08	1.33
10/2/08	0.96	9/18/08	1.21
10/3/08	0.96	9/19/08	1.15
10/4/08	0.96	9/20/08	1.17
10/5/08	0.98	9/21/08	1.18
10/6/08	0.96	9/22/08	1.20
10/7/08	0.97	9/23/08	1.18
10/8/08	0.98	9/24/08	1.20
10/9/08	1.00	9/25/08	1.19
10/10/08	0.98	9/26/08	1.12
10/11/08	0.98	9/27/08	1.00
10/12/08	0.98	9/28/08	0.93
10/13/08	0.98	9/29/08	0.97
10/14/08	0.99	9/30/08	1.05
10/15/08	1.00	10/1/08	0.98
10/16/08	1.01	10/2/08	0.98
10/17/08	0.99	10/3/08	0.92
10/18/08	0.99	10/4/08	0.87
10/19/08	0.97	10/5/08	0.90
10/20/08	0.98	10/6/08	1.09
10/21/08	0.98	10/7/08	1.14
10/22/08	0.97	10/8/08	1.11
10/23/08	0.98	10/9/08	0.94
10/24/08	0.98	10/10/08	0.94
10/25/08	0.97	10/11/08	0.92
10/26/08	0.95	10/12/08	1.06
10/27/08	0.91	10/13/08	1.16
10/28/08	0.92	10/14/08	1.20

10/29/08	0.93	10/15/08	1.26
10/30/08	0.93	10/16/08	1.23
10/31/08	0.93	10/17/08	1.16
11/2/08	0.93	10/18/08	1.03
11/4/08	0.93	10/19/08	1.03
11/5/08	0.94	10/20/08	1.01
11/7/08	0.94	10/21/08	0.97
11/8/08	0.94	10/22/08	0.98
11/9/08	0.94	10/23/08	1.09
11/10/08	0.96	10/24/08	1.26
11/11/08	0.97	10/25/08	1.17
11/12/08	0.96	10/26/08	0.98
11/13/08	0.97	10/27/08	0.75
11/14/08	0.96	10/28/08	0.72
11/15/08	0.98	10/29/08	0.71
11/16/08	0.96	10/30/08	0.70
11/17/08	0.96	10/31/08	0.78
11/18/08	0.96	11/1/08	0.83
11/19/08	0.96	11/2/08	0.85
11/20/08	0.94	11/3/08	0.89
11/21/08	0.94	11/4/08	0.93
11/22/08	0.96	11/5/08	0.95
11/23/08	0.95	11/6/08	0.94
11/24/08	0.96	11/7/08	0.83
11/25/08	0.97	11/8/08	0.75
11/26/08	0.93	11/9/08	0.70
11/27/08	0.96	11/10/08	0.87
11/28/08	0.93	11/11/08	1.01
11/30/08	0.93	11/12/08	1.10
12/1/08	0.93	11/13/08	1.08
12/2/08	0.93	11/14/08	1.07
12/3/08	0.93	11/15/08	0.87
12/5/08	0.93	11/16/08	0.71
12/6/08	0.93	11/17/08	0.69
12/7/08	0.93	11/18/08	0.67
12/9/08	0.93	11/19/08	0.66
12/10/08	0.93	11/20/08	0.66
12/11/08	0.96	11/21/08	0.64
12/12/08	0.92	11/22/08	0.82
12/13/08	0.93	11/23/08	0.87
12/14/08	0.94	11/24/08	0.89
12/15/08	0.95	11/25/08	0.79

12/16/08	0.95	11/26/08	0.77
12/17/08	0.97	11/27/08	0.76
12/18/08	0.93	11/28/08	0.80
12/19/08	0.93	11/29/08	0.79
12/21/08	0.93	11/30/08	0.78
12/22/08	0.93	12/1/08	0.69
12/23/08	0.93	12/2/08	0.65
12/24/08	0.93	12/3/08	0.62
12/25/08	0.93	12/4/08	0.69
12/26/08	0.94	12/5/08	0.65
12/27/08	0.96	12/6/08	0.76
12/28/08	0.95	12/7/08	0.67
12/29/08	0.94	12/8/08	0.65
12/30/08	0.93	12/9/08	0.84
12/31/08	0.93	12/10/08	0.92
		12/11/08	0.75
		12/12/08	0.70
		12/13/08	0.69
		12/14/08	0.93
		12/15/08	1.04
		12/16/08	1.01
		12/17/08	0.93
		12/18/08	0.87
		12/19/08	0.82
		12/20/08	0.73
		12/21/08	0.72
		12/22/08	0.68
		12/23/08	0.88
		12/24/08	1.01
		12/25/08	0.94
		12/26/08	0.90
		12/27/08	0.93
		12/28/08	0.89
		12/29/08	0.88
		12/30/08	0.85
		12/31/08	0.80

SUMMARY OF THE OVERALL WATER STAGE FOR ONE YEAR

Water depths were very similar between the Treatment and Control sites. Both sites had the deepest water in May and December of 2007 (Figures 2 and 3). No action is needed at this time.

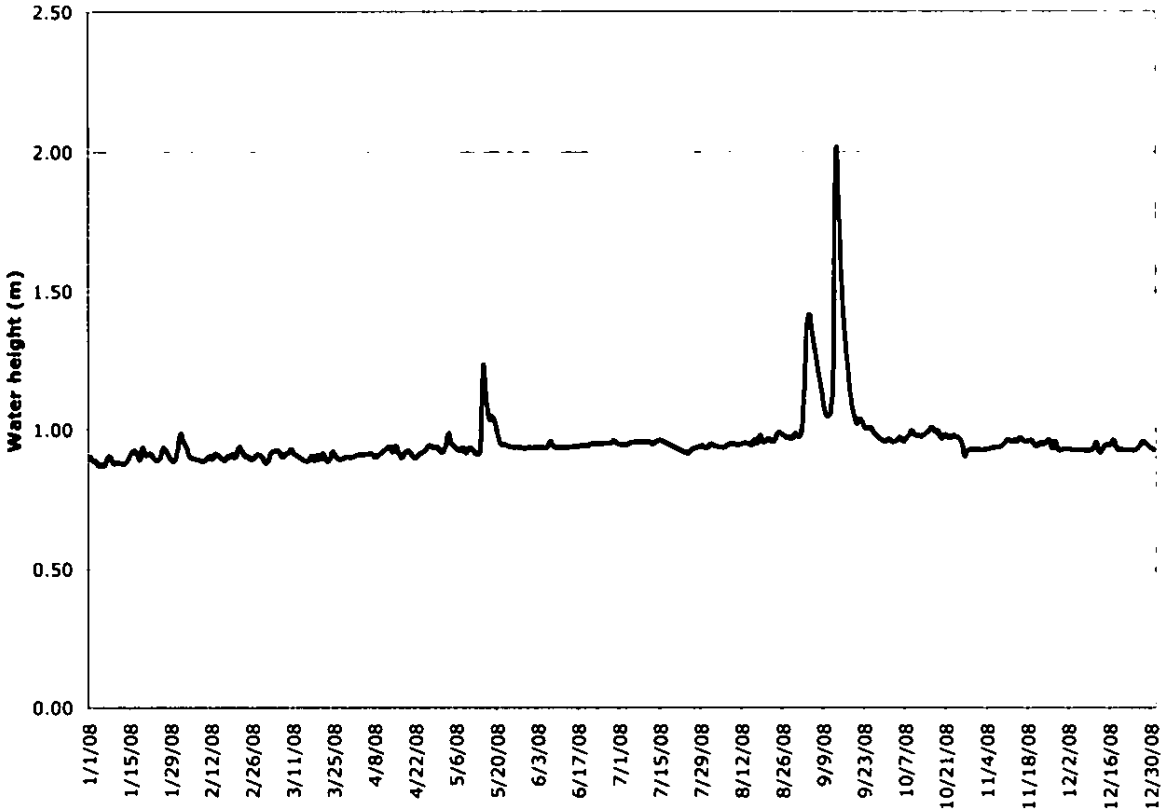

Figure 2. Water depths recorded in the Treatment site at the Hammond Assimilation Wetland in 2008.

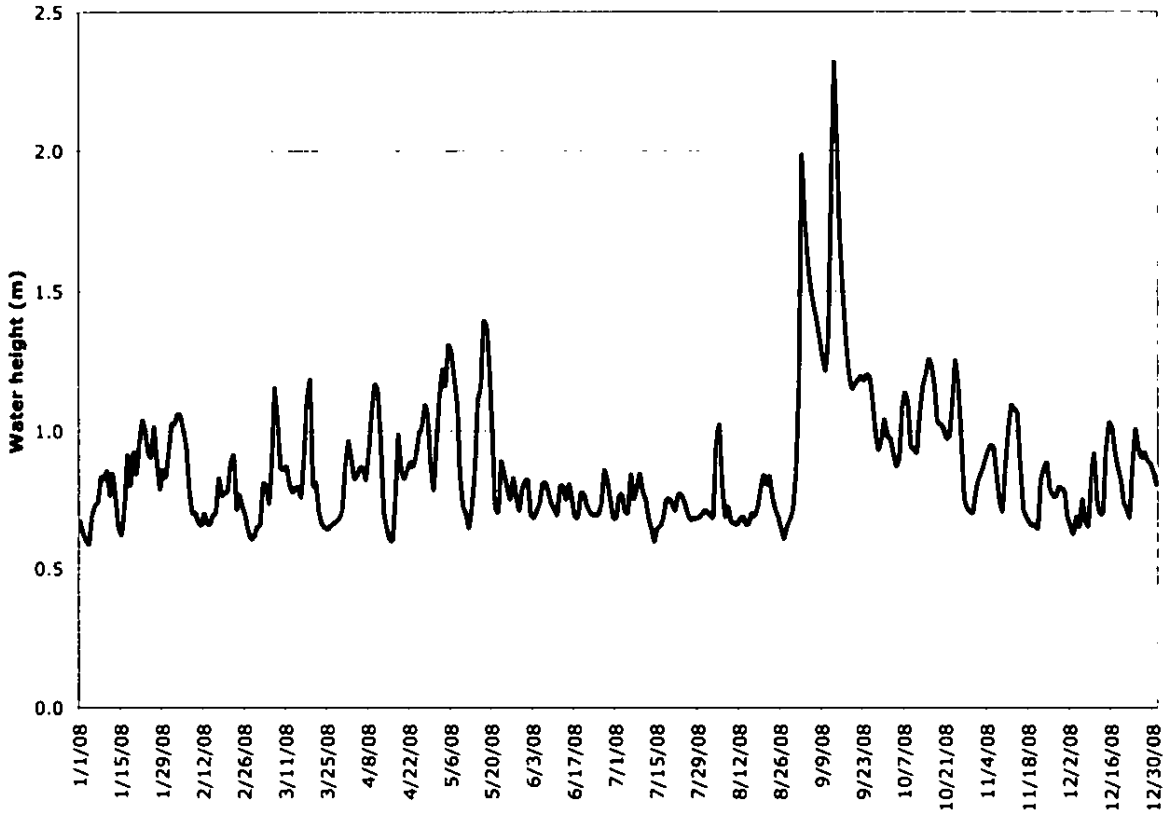

Figure 3. Water depths recorded in the Control site at the Hammond Assimilation Wetland in 2008.

Water Flow Characteristics at the Hammond Wetland Assimilation Site: July, 2009

On July 2, 2009, measurements of water flow at the Hammond site were measured using multiple dye drops. Taking part in the measurements were Drs. John Day, Gary Shaffer, and Charles Sasser, Mr. Jimmy Ernst of the Dept. of Wildlife and Fisheries, Jason Day, Bernard Wood, and Eva Hillmann.

Observations were made at all four boardwalks, in the swamp area to the east and south of the discharge pipe, at the first opening under the railroad south of South Slough, and at the Joyce Wildlife Area boardwalk (Figure 4). The treated effluent was being discharged through the eastern end of the discharge pipe. Because of this, and the recent drought, the only place in the area where there was surface water was downstream of the discharge from the distribution pipe.

There was no surface standing water at the middle and western boardwalks in the assimilation area and at the Joyce boardwalk. There was no flow under the first bridge on the railroad.

Where there was water movement, flow was measured by dropping small amounts of dye (several ml) and monitoring movement of the dye patch over roughly 10-minute periods. At the boardwalk, dye was dropped in the water and the time for the dye patch to move one meter was noted. Note how the water flow separates as it moves through the vegetation (Figure 5-7). The direction of water flow and water depth also were measured. Observations also were made for longer periods of time. Ten to twenty ml of dye was dropped in the water and observations were made for roughly 10 minutes. Estimates of the distance traveled were measured and the direction of dye movement was noted. The longer observations were made at the eastern boardwalk and from the discharge pipe. In addition, Dr. Shaffer and his students walked into the swamp to the location indicated on the photo (Figure 4) and made multiple dye drops and measured direction and velocity of flow.

Figure 4. Location of dye study and water flow at the Hammond assimilation wetland.

Water flow after leaving the discharge pipe was to the southeast (Figure 4). No flow was observed moving to the west. Water depths along the eastern boardwalk were 8-10 cm and flow velocities were 3-4 cm/sec. At the edge of cypress seedling exclosure, flow was 10 cm/sec. For the measurements in the swamp east and south of the discharge, water depths were deeper, ranging from 16 to 30 cm. Current velocities in the swamp 200 meters east of the discharge pipe were 2.08 to 3.33 cm/sec. At 500 meters southeast of the discharge pipe, current velocities were lower, ranging from 0.5 to 1.67 cm/sec. These results indicate that as the water flowed away from the discharge pipe, it spread out and slowed down. For the dye patches that were followed for 5 and 10 minutes, we estimate that water moved about 20-25 m and 30-40 m, respectively. Details of measurements are given in the table below.

These measurements represent water flow movement under extremely dry conditions with discharge from the eastern end of the discharge pipe. We plan to repeat the measurements when rainfall returns to more normal conditions and with the discharge from different locations along the discharge pipe.

Water flow velocities and water depths during the July dye study.
All flows were in a southeasterly direction.

Discription of measurement site	velocity cm/sec	Depth cm
Ditch at east end of pipeline	0.10	22
200 meters east of pipeline, Ten meters of edge in marsh	3.33	16
200 meters east of pipeline, Ten meters of edge in marsh	2.50	16
200 meters east of pipeline, Ten meters of edge in marsh	2.08	16
300 meters east of pipeline,15 meters off edge in marsh	0.33	20
500 meters east of pipeline, 5 meters off edge in swamp	1.67	20
500 meters east of pipeline, 5 meters off edge in swamp	0.83	20
500 meters east of pipeline, 5 meters off edge in swamp	0.50	20
500 meters east of pipeline, 100 meters off edge in swamp	0.50	30
500 meters east of pipeline, 400 meters off edge in swamp	1.67	30
500 meters east of pipeline, 400 meters off edge in swamp	1.50	30
500 meters east of pipeline, 400 meters off edge at swamp marsh interface	0.55	30

500 meters east of pipeline, 300 meters off edge interior swamp	0.87	30
East boardwalk, 10 m, at edge of exclosure	10.00	10
East boardwalk, 20 m	3.70	10
East boardwalk, 30 m	4.00	8
East boardwalk, 40 m	3.13	10
East boardwalk, 50 m	3.33	9

Figure 5. Dropping dye into the water at the Hammond assimilation wetland.

Figure 6. Movement of tracer dye through the water at the Hammond assimilation wetland.

Figure 7. Movement of tracer dye through the water at the Hammond assimilation wetland. Note how dye moves around vegetation.

NUTRIENT ANALYSIS I (Surface Water)

Surface water samples were collected quarterly and taken to an EPA-approved laboratory for analysis.

PARAMETER	NUTRIENT ANALYSIS I (Surface Water)												
	Wastewater Treatment Area							Control Area					
	UAA Average (mg/L)			Current Average (mg/L)			Difference[1]	UAA Average (mg/L)		Current Average (mg/L)		Difference[1]	ANOVA Significant Difference[2] (p=0.05) YES or NO
	Treatment Area (mean ± standard error)			Treatment Area (mean ± standard error)				Control Area (mean ± standard error)		Control Area (mean ± standard error)			
	TMT	MID	OUT	TMT	MID	OUT		FC[3]	MC[4]	FC	MC		
Total Kjeldahl Nitrogen (TKN)	ND[5]	ND	ND	7.26± 4.40	3.24± 1.56	1.00± 0.29	ND	ND	ND	0.58± 0.22	0.86± 0.16	ND	FC = N MC = N,N
Total Phosphorus (TP)	0.46± 0.38	0.11± 0.04	0.11± 0.02	2.50± 0.39	1.44± 0.87	0.07± 0.03	1,0,0	0.60± 0.49	0.39± 0.29	0.13± 0.03	0.06± 0.02	0,0	FC = N MC = Y,N

[1] The difference in the UAA value and the current value shall be indicated by NO INCREASE=0, INCREASE=1, and DECREASE=2.
[2] Analysis of Variance (ANOVA), a significant difference (p=0.05) between the wastewater treatment area and the control area shall be indicated by YES or NO.
[3] Forested Control.
[4] Marsh Control.
[5] Not determined because no data were available.

NUTRIENT ANALYSIS I (Surface Water) continued:

ANALYSIS OF VARIANCE (ANOVA):

Has there been a significant difference (p=0.05) between the Nutrient Analysis I (Surface Water) in the control and the treatment area?

As indicated in the table as YES or NO .

If yes, please explain the significant differences between the control and the treatment areas and outline any corrective actions taken, if needed.

Total Kjeldahl Nitrogen (TKN) was not measured during the UAA study and, therefore, could not be compared to current concentrations. There were no differences in mean TKN concentrations measured among the March Control, Out or Treatment sites (P = 0.1835). No differences were measured in mean TKN concentrations between the Forested Control and the Mid sites (P = 0.1016).

Mean concentration of Total Phosphorus (TP) was higher in the Treatment site in 2008 than in the pre-discharge period, but no differences were observed for the Marsh Control or Out sites. Mean TP measured in 2008 was significantly higher in the Treatment site than in the Marsh Control or Out sites. It is expected that nutrient concentrations will be higher in the Treatment site than in the other sites because that is where the treated effluent is discharged. However, because no differences were observed between mean TP measured in the Marsh Control and Out sites, this shows that the wetland is able to effectively assimilate the added phosphorus. No differences were measured in mean TP concentrations between the Forested Control and the Mid sites (P = 0.1316).

NUTRIENT ANALYSIS II (Surface Water)

PARAMETER	NUTRIENT ANALYSIS II (Surface Water)											
	Wastewater Treatment Area							Control Area				ANOVA Significant Difference[2] (p=0.05) YES or NO
	UAA Average (mg/L)			Current Average (mg/L)			Difference[1]	UAA Average (mg/L)		Current Average (mg/L)		Difference[1]	
	Treatment Area (mean ± standard error)			Treatment Area (mean ± standard error)				Control Area (mean ± standard error)		Control Area (mean ± standard error)			
	TMT	MID	OUT	TMT	MID	OUT		FC[3]	MC[4]	FC	MC		
Ammonium (NH_4-N)	0.03± 0.02	0.01± 0.005	0.03± 0.01	5.79± 2.99	0.40± 0.38	0.03± 0.01	1,0,0	0.05± 0.03	0.03± 0.01	0.03± 0.01	0.03±0.01	0,0	FC = N MC = N,N
Nitrate+Nitrite Nitrogen (NO_3+NO_2-N)	BDL[5]	0.05± 0.02	BDL	1.94± 1.20	0.16± 0.11	0.10± 0.03	0,0,0	BDL	BDL	0.11± 0.03	0.09±0.03	0,0	FC = N MC = N,N
Phosphate (PO_4-P)	ND[6]	ND	ND	2.23± 0.53	1.25± 0.78	0.01± 0.01	ND	ND	ND	0.04± 0.02	0.01±0.01	ND	FC = N MC = Y,N

[1] The difference in the UAA value and the current value shall be indicated by **NO INCREASE=0, INCREASE=1, DECREASE=2**.
[2] Analysis of Variance (ANOVA), a significant difference (p=0.05) between the wastewater treatment area and the control area shall be indicated by YES or NO.
[3] Forested Control.
[4] Marsh Control.
[5] Below detection limit.
[6] Not determined.

PHYSICAL WATER PARAMETERS

Dissolved oxygen (DO), conductivity, temperature, salinity, and pH were measured in surface water at each site. Data are missing for some sites because no surface water was present or because surface water was not deep enough to use the YSI meter or the site was dry.

PARAMETER	PHYSICAL WATER PARAMETERS											
	Wastewater Treatment Area							Control Area				
	UAA Average (mg/L)			Current Average (mg/L)			Difference[1]	UAA Average (mg/L)		Current Average (mg/L)		Difference[1]	ANOVA Significant Difference[2] (p=0.05) YES or NO
	Treatment Area (mean ± standard error)			Treatment Area (mean ± standard error)				Control Area (mean ± standard error)		Control Area (mean ± standard error)			
	TMT	MID	OUT	TMT	MID	OUT		FC[3]	MC[4]	FC	MC		
Dissolved Oxygen	0.55± 0.40	0.81± 0.21	2.84± 1.33	0.98± 0.37	2.40± 0.56	3.42± 0.93	0,0,0	3.92± 1.86	3.70± 2.04	2.52± 0.90	2.27± 0.43	0,0	FC = N MC =
Temp	22.60± 6.06	17.70± 6.13	20.06± 7.43	24.09± 2.17	22.16± 2.56	24.66± 2.03	0,0,0	19.22± 6.51	27.30± 4.10	23.47± 1.51	23.87± 2.36	0,0	FC = N MC =
Salinity	0.30± 0.26	0.23± 0.21	0.38± 0.25	0.29± 0.03	0.30± 0.10	1.13± 0.47	0,0,0	0.14± 0.09	0.35± 0.49	0.44± 0.22	1.00± 0.53	0,0	FC = N MC =
pH	5.43± 0.00	5.62± 0.03	6.15± 0.45	7.11± 0.28	7.12± 0.20	6.82± 0.24	0,0,0	5.94± 0.17	6.08± 0.23	6.67± 0.25	6.64± 0.21	0,0	FC = N MC =
TSS	ND[5]	ND	ND	11.25± 5.62	18.67± 8.64	9.75± 3.97	ND	ND	ND	6.65± 1.03	12.25± 4.48	ND	FC = N MC = N,N

[1]The difference in the UAA value and the current value shall be indicated by **NO INCREASE=0, INCREASE=1, DECREASE=2.**
[2]Analysis of Variance (ANOVA), a significant difference (p=0.05) between the wastewater treatment area and the control area shall be indicated by YES or NO.
[3]Forested Control.
[4]Marsh Control.
[5]Not determined.

PHYSICAL WATER PARAMETERS continued:

ANALYSIS OF VARIANCE (ANOVA):

Has there been a significant difference (p=0.05) between the Nutrient Analysis II (Surface Water) in the control and the treatment area?

As indicated in the table as YES or NO.

If yes, please explain the significant differences between the control and the treatment areas and outline any corrective actions taken, if needed.

No differences were measured between 2008 values and those measured prior to discharge for any of the parameters.

No differences were measured in mean dissolved oxygen (DO) concentration among the Mid and Forested Control sites (P = 0.9109) but mean DO measured in the Treatment site was significantly lower than that measured in the Out site (P = 0.0433).

No differences were measured in mean temperature among the Mid and Forested Control sites (P = 0.6665) and no differences were measured among the Treatment, Out, and Marsh Control sites (P = 0.9663).

No differences were measured in mean salinity among the Mid and Forested Control sites (P = 0.5660) and no differences were measured among the Treatment, Out, and Marsh Control sites (P = 0.3161).

No differences were measured in mean pH among the Mid and Forested Control sites (P = 0.1913) and no differences were measured among the Treatment, Out, and Marsh Control sites (P = 0.3940).

No differences were measured in mean Total Suspended Solids (TSS) concentration among the Mid and Forested Control sites (P = 0.1624) and no differences were measured among the Treatment, Out, and Marsh Control sites (P = 0.9324).

NUTRIENT ANALYSIS II (Surface Water) continued:

ANALYSIS OF VARIANCE (ANOVA):

Has there been a significant difference (p=0.05) between the Nutrient Analysis II (Surface Water) in the control and the treatment area?

As indicated in the table as YES or NO.

If yes, please explain the significant differences between the control and the treatment areas and outline any corrective actions taken, if needed.

Mean ammonium concentration measured in 2008 was higher in the Treatment site than concentration measured in the pre-discharge period, but no differences were seen in the Mid, Out, Swamp Control, or Marsh Control sites. No differences were detected between mean ammonium concentrations in the Mid and Forested Control sites (P = 0.2945) or between concentrations measured among the Treatment, Out, and Marsh Control sites (P = 0.0670).

No differences were measured between mean nitrate+nitrite concentrations measured in 2008 and the pre-discharge period for any of the sites. No differences were detected between mean nitrate+nitrite concentrations in the Mid and Forested Control sites (P = 0.6098) or between concentrations measured among the Treatment, Out, and Marsh Control sites (P = 0.1481).

No differences were detected between mean ortho-phosphate concentrations in the Mid and Forested Control sites (P = 0.1316). Mean ortho-phosphate concentration was significantly higher in the Treatment site than in the Out or Marsh Control sites (P = 0.0008).

ISSUES AND CONCERNS

Nutria overgrazing is a problem in wetlands in Louisiana. The Coastwide Nutria Control Program estimates that about 100,000 acres of wetlands are presently impacted by nutria. Without sustained reduction of nutria populations, wetland restoration efforts will be significantly hampered. Federal funding was provided for a nutria control program within Louisiana and the program was implemented by the Louisiana Department of Wildlife and Fisheries. The program pays trappers up to $4 per nutria harvested. We recommend that active nutria harvesting be implemented within the Hammond assimilation wetland and nearby control wetland to reduce the nutria population.