

TMDL COMPLIANCE FOR PATRICK AIR FORCE BASE AND CAPE CANAVERAL AIR FORCE STATION

RETHINKING STORMWATER POLLUTION MANAGEMENT



March 2011

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				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
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a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

TMDL

TOTAL MAXIMUM DAILY LOAD

**MAXIMUM POLLUTANT LOADING THAT CAN
BE DISCHARGED TO A WATER BODY
WITHOUT DEGRADING ITS DESIGNATED USE**

FLORIDA TMDLS

**EXPRESSED AS MASS ANNUAL
LOAD REDUCTION**

POUNDS/YR OF TN OR TP

FLORIDA TMDL PROCESS

- EPA PASSES TMDL FOR EACH IMPAIRED WATER BODY IN STATE
- EPA DELEGATES ENFORCEMENT TO FDEP
- FDEP CREATES TMDL WITH EPA'S APPROVAL
- COMPLIANCE IS THROUGH BASIN MANAGEMENT ACTION PLAN (BMAP) PROCESS

TMDL COMPLIANCE

- **ENFORCEMENT IS THROUGH NPDES MS4 PERMIT**
- **PAFB HAS AN MS4 PERMIT**
- **CCAFS DOES NOT HAVE MS4 PERMIT – FDEP WILL PASS SECRETARIAL ORDER FOR CCAFS ENFORCEMENT**

WHY SHOULD AIR FORCE COMPLY WITH STATE REGULATION?

EPA WOULD STEP IN AND ENFORCE

**PUTS MILITARY INTO CIVILIAN
RULEMAKING AND COMPLIANCE ARENA!**

TMDL METHODOLOGY

- EACH WATERBODY ANALYZED INDEPENDENTLY TO DETERMINE POLLUTANTS OF CONCERN
- EACH WATERBODY HAS UNIQUE BIOLOGICAL BASED MODEL FOR POLLUTANT LOADINGS – PLSM, HSPF, SLAMM, ETC.
- **FDEP** DEVELOPS MODEL FOR OVERALL WATERBODY TO CALCULATE NUTRIENT REDUCTIONS REQUIRED BY ALL STAKEHOLDERS

BMAP PROCESS

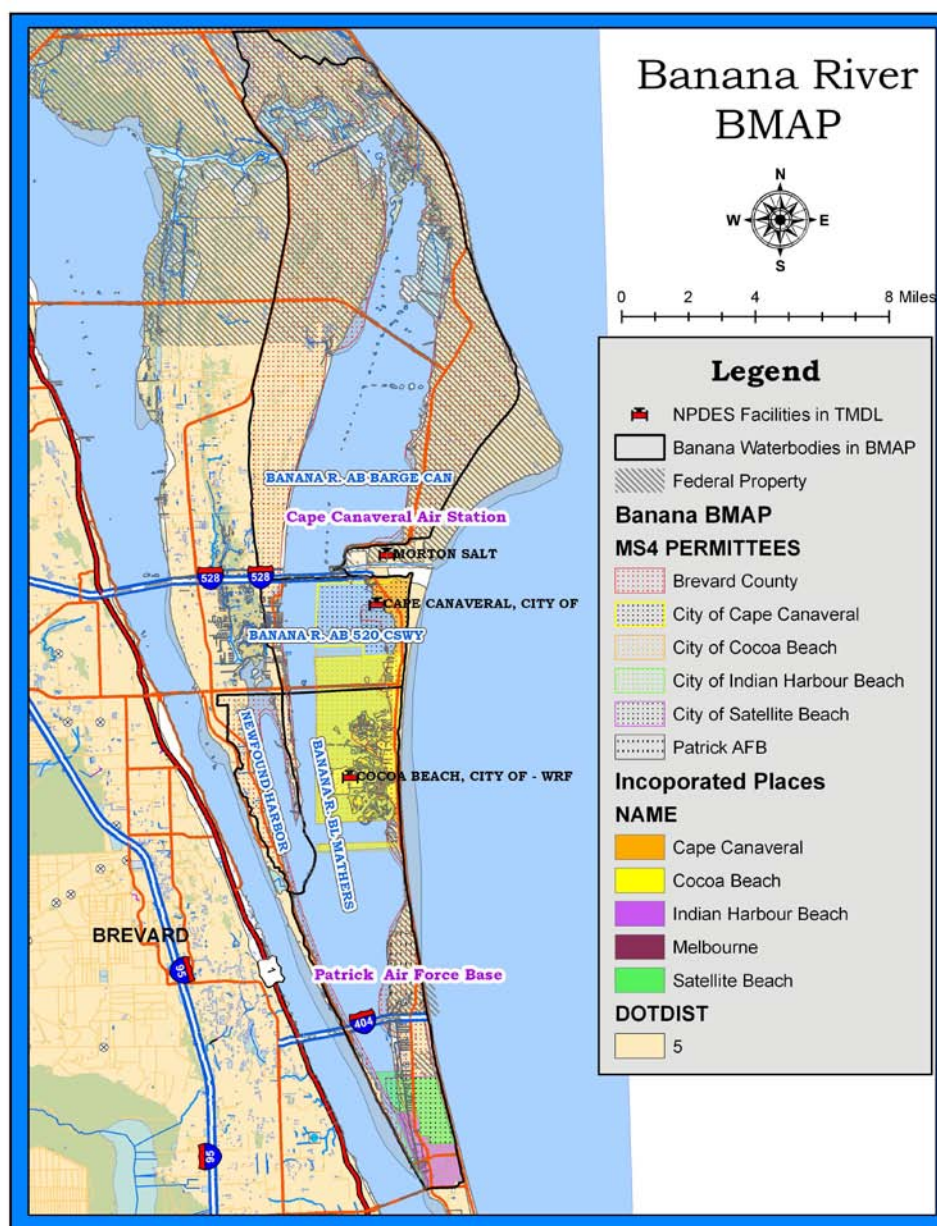
**FDEP WORKS COLLABORATIVELY
WITH STAKEHOLDERS TO:**

- **DISTRIBUTE LOAD REDUCTIONS AMONG MS4 PERMITEES**
- **OBTAIN COMMITMENTS FROM PERMITEES FOR MEASURES TO REDUCE POLLUTANT LOADS**

MILITARY PARTICIPATES IN RULEMAKING

- **RULES ARE NOT HARDFAST**
- **MS4 ENTITIES MUST AGREE TO LOAD CALCULATION METHODS, ALLOCATION BETWEEN ENTITIES, AND METHODS UTILIZED FOR COMPLIANCE**
- **DISAGREEMENTS CAN BE NEGOTIATED WITH FDEP**

BANANA RIVER LAGOON PERMITEES



BANANA RIVER LAGOON (BRL) IMPAIRMENT

- **SEAGRASS COVERAGE HAS DECLINED**
- **RESTORE SEAGRASS TO HISTORIC LEVELS**
- **REDUCE OVERALL TN AND TP
THROUGHOUT BRL IN ATTEMPT TO
RESTORE SEAGRASS COVERAGES**
- **NO CAUSATIVE CORRELATION BETWEEN
NUTRIENTS AND SEAGRASSES**

PLSM POLLUTANT LOAD MODEL

- **GIS SPREADSHEET MODEL DEVELOPED BY ST JOHNS RIVER WATER MANAGEMENT DISTRICT IN 1995**
- **ADOPTED BY EPA AND FDEP**
- **USES YEAR 2000 COVERAGES**

PLSM VARIABLES

- LAND USE
- SOIL TYPE
- ANNUAL RAINFALL
- RUNOFF COEFFICIENT “C”
- POLLUTANT CONCENTRATION BY LAND USE

PLSM CALCULATIONS

Basin ID	Land Use and Soil	Annual C	TN mg/L	TP mg/L	Annual Rainfall in	Area ac	Volume ac-ft/yr	Treatment	TN Reduction	TP Reduction	TN Load lb/yr	TP Load lb/yr
1A	1730 C	0.77	1.80	0.48	46.66	2.47	7.38	No	1.00	1.00	36.14	9.60
1A	8140 C	0.78	1.18	0.48	46.66	0.16	0.49	No	1.00	1.00	1.59	0.65
1A	8140 C	0.78	1.18	0.48	46.66	0.30	0.91	No	1.00	1.00	2.93	1.19
1A	8140 C	0.78	1.18	0.48	46.66	0.06	0.19	Yes	0.70	0.50	0.42	0.12
	Total					3.00	8.98				41.08	11.56

BANANA RIVER LAGOON BMAP ALLOCATIONS

JULY 2010

Banana River Lagoon (BRL) Basin Management Action Plan (BMAP) Required Reductions

Required TN Reductions for the BRL BMAP

Entity	Area (acres)	TN Target (lbs/acre)	TN Target (lbs)	Base Load (lbs)	Required Reduction (lbs)	Required Reduction (%)	BMAP 1 Required Reduction (lbs)
Brevard County	10,470	2.32	24,283	75,489	51,206	67.8%	17,068.7
Cape Canaveral	856	2.32	1,985	8,945	6,960	77.8%	2,320.2
Cape Canaveral AFS	13,795	2.32	31,994	53,007	21,013	39.6%	7,004.4
Cocoa Beach	1,857	2.32	4,307	18,759	14,452	77.0%	4,817.5
FDOT 5	386	2.32	895	3,741	2,846	76.1%	948.5
Indian Harbour Beach	1,251	2.32	2,901	11,908	9,007	75.6%	3,002.4
Kennedy Space Center	18,540	2.88	53,324	70,816	17,492	24.7%	5,830.7
Patrick AFB	2,134	2.32	4,948	28,994	24,046	82.9%	8,015.3
Satellite Beach	1,488	2.32	3,451	13,952	10,501	75.3%	3,500.3
<i>de minimus</i>	609	-	2,954	2,954	0	0.0%	0.0
Total	51,385	-	128,087	288,565	157,524	54.6%	52,508.0

Required TP Reductions for the BRL BMAP

Entity	Area (acres)	TP Target (lbs/acre)	TP Target (lbs)	Base Load (lbs)	Required Reduction (lbs)	Required Reduction (%)	BMAP 1 Required Reduction (lbs)
Brevard County	10,470	0.344	3,606	14,741	11,135	75.5%	3,711.8
Cape Canaveral	856	0.344	295	1,957	1,663	84.9%	554.2
Cape Canaveral AFS	13,795	0.344	4,751	10,790	6,039	56.0%	2,013.0
Cocoa Beach	1,857	0.344	640	3,781	3,141	83.1%	1,047.2
FDOT 5	386	0.344	133	1,076	943	87.6%	314.4
Indian Harbour Beach	1,251	0.344	431	2,092	1,662	79.4%	553.8
Kennedy Space Center	18,540	0.344	6,385	8,576	2,191	25.5%	730.4
Patrick AFB	2,134	0.344	735	7,500	6,766	90.2%	2,255.2
Satellite Beach	1,488	0.344	512	2,462	1,949	79.2%	649.8
<i>de minimus</i>	609	-	566	566	0	0.0%	0.0
Total	51,385	-	18,053	53,543	35,489	66.3%	11,829.7

BRL BMAP ALLOCATIONS

- **NOT END OF PIPE CONCENTRATION BASED!**
- **15 YEARS TO MEET ANNUAL LOAD REDUCTIONS**
- **MEET 1/3 OF REDUCTION IN 3 EQUAL 5 YEAR CYCLES**
- **REASSESS SEAGRASS COUNTS AT END OF EACH 5 YEAR CYCLE AND ADJUST ALLOCATIONS IF NEEDED**

REDUCTIONS FROM EXISTING DEVELOPED AREAS

- **NOT ASSOCIATED WITH EISA 438 OR STATE PERMITTING REQUIREMENTS OF 1.5 INCHES OF TREATMENT VOLUME**
- **ASSUME NEW DEVELOPMENT CREATES NO NEW POLLUTANT LOADS**
- **ALL COMPLIANCE BY RETROFITTING EXISTING DEVELOPED AREAS TO REDUCE EXISTING LOADINGS**

MODEL REVIEW

- **INACCURATE COVERAGES FOR 2000**
- **SEAGRASSES HAVE REBOUNDED**
- **OVERESTIMATION OF RUNOFF VOLUMES AND POLLUTANT LOADS**
- **FDEP INTERDEPARTMENTAL DISPUTES ON MODELING METHODS**

Patrick Air Force Base
Sturgis Sells
Brevard County, Florida
Frame 3 of 5

Key
Base Boundary
Base
Base
Base
Base
Base
Base
Base
Base

Source: ESRI, 2010; Bing Maps, 2010
Copyright: 2010, ESRI, Inc.



PAFB INACCURATE LAND USE COVERAGE

Patrick Air Force Base
2000 SJRWMD FLUCCS
Brevard County, Florida
Frame 4 of 6

Key:

USAF Boundary

Legend
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Overview



Source: ESRI 2008; Bing Maps 2009;
Specpro 2009; SJRWMD 2000 FLUCCS.



1 inch = 300 feet



CCAFS INACCURATE SOILS

Cape Canaveral
SSURGO Soils
Brevard County, Florida
Frame 4 of 6

Key:

USAF Boundary

Soils

A

B

B/C

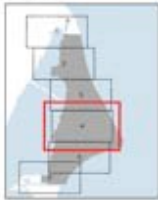
C

D

U

W

Overview



Sources: ESRI 2008; USFWS WWT;
Ring Maps 2009; Speer 2009; 2005 NRCS.



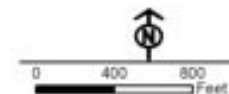
1 in = 1,000 ft



PAFB CREDITS FOR BMPS CONSTRUCTED PRE 2000



- TMDL Jurisdictional Boundary - E&E and SSI
- ERP Projects Area - USAF
- Treatment Area - FDEP



Treatment Grid & ERP Projects

Frame 5 of 8
Patrick Air Force Base
Brevard County, Florida
TMDL study by E&E and SSI

Date: 9/21/2010
Source: Bing Maps, 2010; FDEP 2010

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NEGOTIATED COST REDUCTIONS

July 2010 First 5 Year Reduction				April 2011 First 5 Year Reduction		
	TN Reduction lb/yr	TP Reduction lb/yr	Project Costs	TN Reduction lb/yr	TP Reduction lb/yr	Project Costs
CCAFS	7,004	2,013	\$7,478,439	3,140	948	\$2,478,000
PAFB	8,015	2,255	\$3,860,396	3,046	875	\$1,241,424

RETROFITTING – DIFFICULT CONSTRUCTION



BMP SELECTION

- WET DETENTION PONDS
- DRY RETENTION PONDS
- BEEMATS FLOATING WETLANDS
- REUSE OF GOLF COURSE LAKE WATER

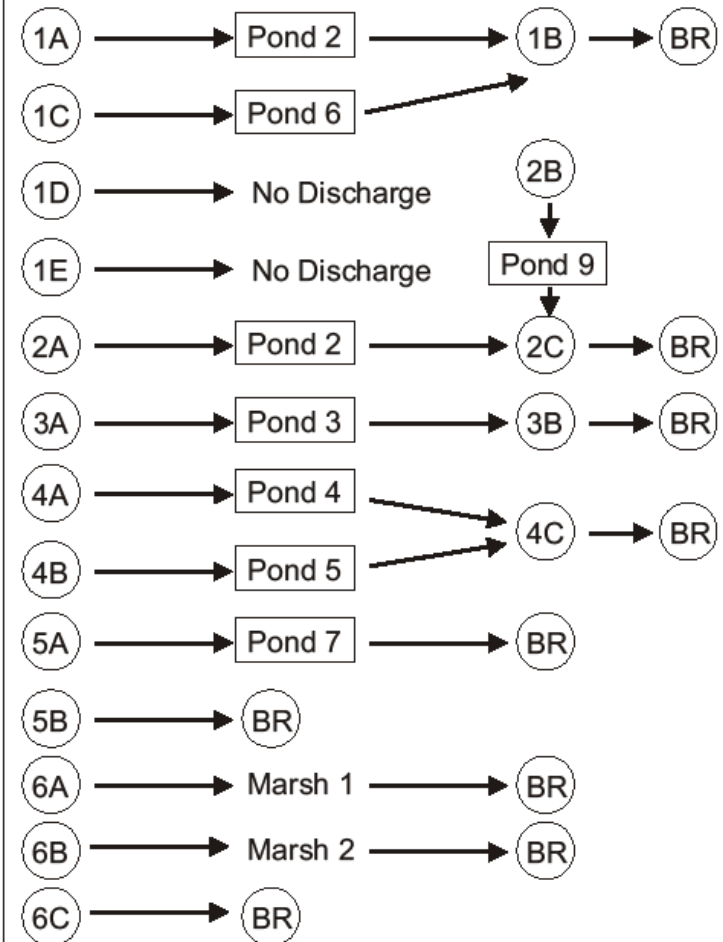


PAFB POLLUTANT FLOW PATH NODE DIAGRAM

02-002885.SP16.02.CCAFS_PG1.cdr-6/28/10-GRA



ecology and environment, inc.
Global Specialists in the Environment



SOURCE: Ecology and Environment, Inc. 2010

6/28/2010

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CCAFS Node Diagram

WET DETENTION POND REMOVAL EFFICIENCIES

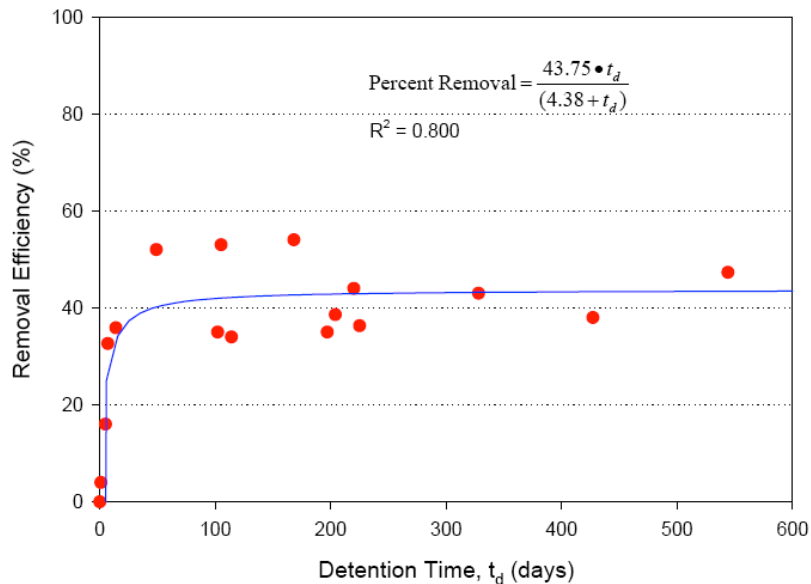
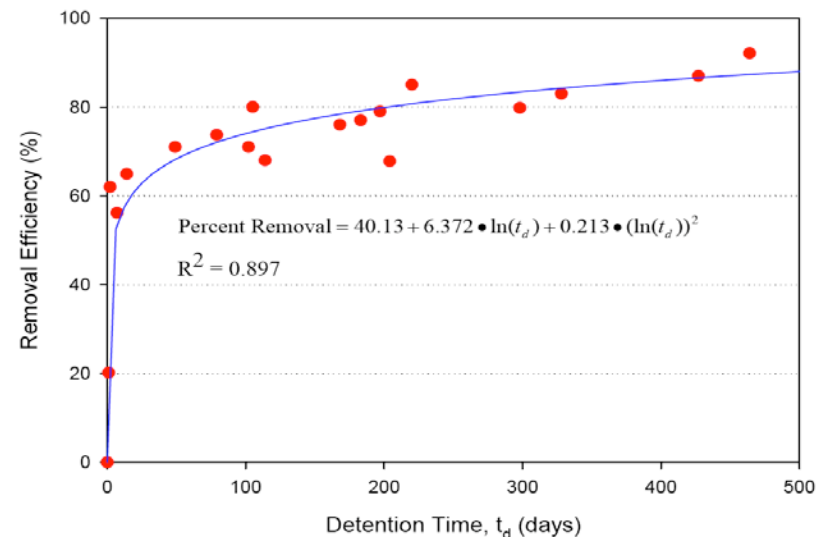


Figure 5-10. Removal Efficiency of Total Nitrogen in Wet Detention Ponds as a Function of Residence Time.

TP Removal Efficiency



BMP REMOVAL EFFICIENCIES

BMP	TP % Reduction	TN % Reduction
Retention BMPs (basin, exfiltration, etc.)	Based on DCIA, non-DCIA CN, and Rainfall Zone	Based on DCIA, non-DCIA CN, and Rainfall Zone
Wet Detention Ponds	Annual Residence Time	Annual Residence Time
Dry Detention	10	10
Treatment Trains	Use BMP Treatment Train (TT) equation: $\text{BMP TT Efficiency} = \text{Eff1} + ((1 - \text{EFF1}) * \text{Eff2})$	Use BMP Treatment Train (TT) equation: $\text{BMP TT Efficiency} = \text{Eff1} + ((1 - \text{EFF1}) * \text{Eff2})$
Baffle Box	2.3	0.5
Nutrient Baffle Box	15.5	19.05
Catch Basin Inserts, inlet filters	Based on pounds material removed	Based on pounds material removed
Grass Swales with swale blocks or raised culverts	Use retention BMPs above	Use retention BMPs above
Alum Injection	90	50
Provisional BMPs	TP % Reduction	TN % Reduction
Street Sweeping	Pounds material removed x concentration from FSA study	Pounds material removed x concentration from FSA study
Stormceptor	13	2
CDS Unit	10	NA
Public Education	1-6, depending on program	1-6, depending on program

PAFB TMDL PROJECTS

First Five Year Cycle Recommended Structural Best Management Practices						
Project No.	BMP Type	TN Reduction (lb/yr)	TP Reduction (lb/yr)	Estimated Cost	Cost per pound TN Removed	Cost per Pound TP Removed
4B	Beemats	509.24	811.31	\$59,629	\$117	\$ 73
24B	Beemats	55.65	14.78	\$10,468	\$188	\$708
26A	Reuse	3,056.32	965.42	\$850,000	\$278	\$880
22	Dry Pond	67.84	18.01	\$25,000	\$369	\$1,388
28	Dry Pond	164.12	43.58	\$75,600	\$461	\$1,735
5A	Dry Swale	24.75	6.57	\$15,000	\$606	\$2,283
4A	Wet Pond	799.58	383.53	\$504,900	\$631	\$1,316
11	Dry Pond	82.22	21.83	\$52,920	\$644	\$2,424
26B	Beemats	916.44	241.36	\$605,806	\$661	\$2,510
13	Dry Pond	39.81	10.84	\$36,590	\$919	\$3,375
5B	Dry Swale	16.88	4.45	\$16,223	\$961	\$3,646
2	Dry Pond	24.76	6.58	\$24,192	\$977	\$3,678
10	Dry Pond	27.78	7.38	\$27,972	\$1,007	\$3,792
12	Dry Swale	35.22	9.35	\$36,288	\$1,030	\$3,881
23	Dry Pond	25.60	6.80	\$27,972	\$1,093	\$4,113
8	Dry Pond	44.22	11.74	\$56,700	\$1,282	\$4,828
9	Dry Pond	9.96	2.65	\$13,797	\$1,385	\$5,214
3	Dry Swale	16.10	4.28	\$30,000	\$1,863	\$7,011
21	Dry Swale	6.74	1.79	\$12,569	\$1,864	\$7,009
16	Dry Pond	39.63	11.24	\$84,718	\$2,137	\$7,540
24A	Wet Pond	101.45	45.69	\$226,800	\$2,236	\$4,964
6	Dry Pond	11.42	3.03	\$31,450	\$2,753	\$10,364
7	Dry Pond	18.89	5.02	\$76,356	\$4,041	\$15,219
1	Wet Pond	130.22	58.75	\$661,500	\$5,080	\$11,260
27	Dry Pond Expansion	32.42	8.61	\$227,764	\$7,026	\$26,458
15	Dry Pond	5.76	1.53	\$70,182	\$12,192	\$45,757
Total		6,263.03	2,706.11	\$3,860,396		

PAFB PROPOSED BMPS

Patrick Air Force Base
Proposed Project Locations
TMDL study by E&E and SSI
Brevard County, Florida

Oct 21, 2010

Frame 2 of 6

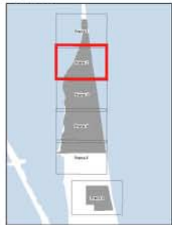
Key

— Proposed Project

▭ Subbasins

▭ USAF Boundary

Overview



Source:
MS Virtual Earth Aerial 2008
SSI Basin Boundaries 2010
SSI Proposed Projects 2010



1 inch = 300 feet

0 125 250 500 750 1,000 Feet

0 0.1 0.2 Miles

CCAFS PROPOSED PROJECTS

Cape Canaveral Air Force Station
Proposed Project Locations
TMDL study by E&E and SSI
Brevard County, Florida

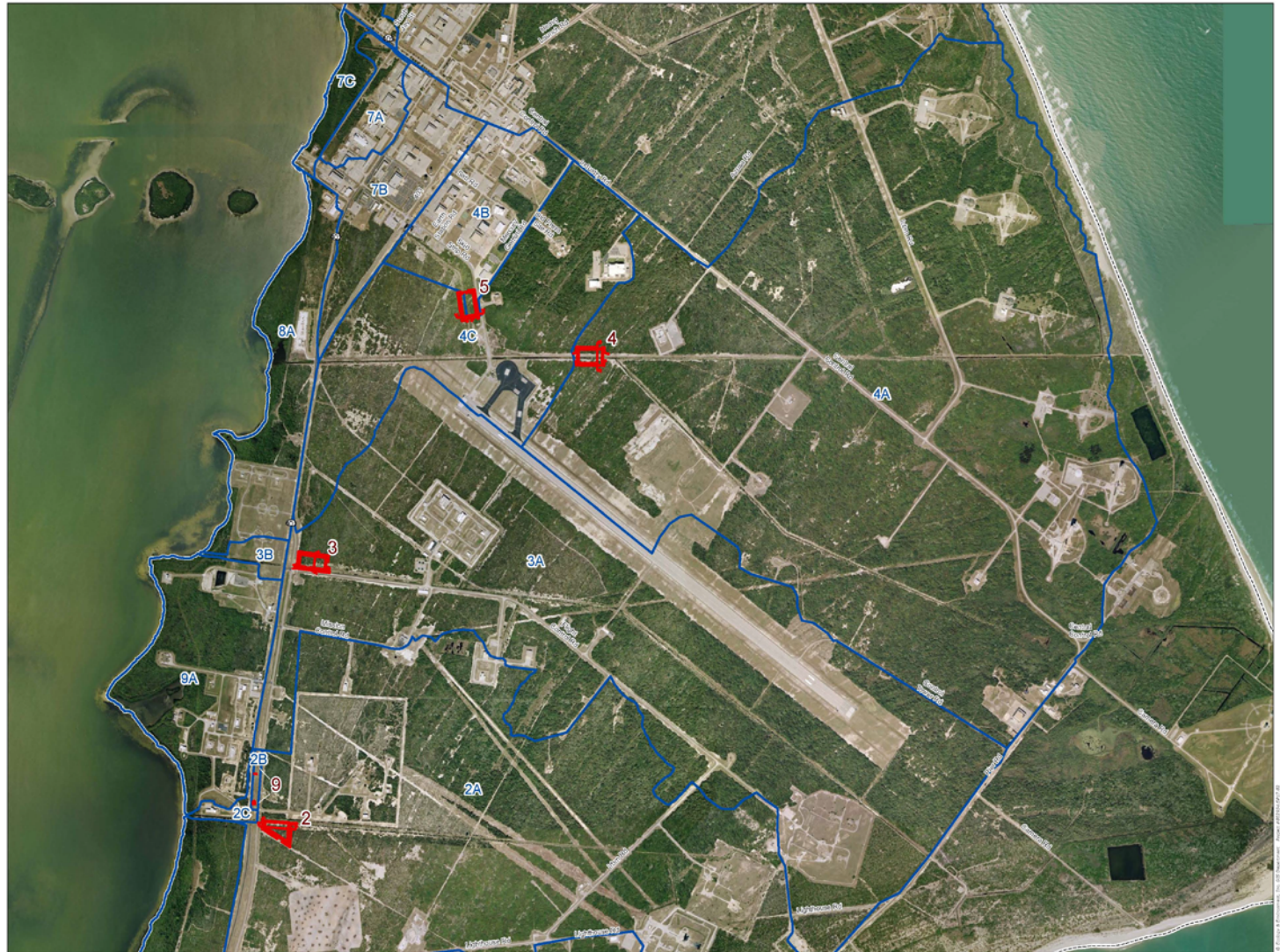
Oct 15, 2010

Frame 4 of 6

Key

- Proposed Project
- Subbasins
- USAF Boundary

Overview



Source:
MS Virtual Earth Aerial 2008
SSI Basin Boundaries 2010
SSI Proposed Projects 2010
ESRI 2009



1 inch = 1,000 feet



CCAFS TMDL PROJECTS

Project No.	BMP Type	Acres Treated	TN Removed (lb/yr)	TP Removed (lb/yr)	Estimated Cost	Cost per Lb TN Removed/Yr	Cost per Lb TP Removed/Yr
11	Beemats	208.32	436.0	113.1	\$22,477	\$52	\$199
6	Dry Swales	5.66	32.9	9.6	\$10,000	\$304	\$1,045
10	Dry Pond	7.97	44.1	12.7	\$35,000	\$793	\$2,756
3	Wet Pond	1434.8	1,403.1	800.6	\$1,204,000	\$858	\$1,504
4	Wet Pond	1747.16	1,171.0	583.7	\$1,274,000	\$1,088	\$2,183
1	Wet Pond	1202.61	729.6	371.2	\$854,000	\$1,171	\$2,300
7	Wet Pond	2044.03	2,269.9	879.3	\$2,744,000	\$1,209	\$3,120
2	Wet Pond	1284.63	731.7	283.4	\$1,218,000	\$1,665	\$4,298
5	Wet Pond	153.42	573.8	247.8	\$1,036,000	\$1,806	\$4,181
9	Dry Swales	3.91	37.5	15.3	\$85,000	\$2,265	\$5,568
15	Dry Pond	3.87	22.5	6.5	\$54,432	\$2,418	\$8,324
Totals		7,888	7,430	3,317	\$8,536,909		

PAFB COMPLIANCE STRATEGY

	TN (lb/yr)	TP (lb/yr)
FDEP Required 15 Year Reduction	20,306	5,835
FDEP Required 5 Year Reduction	3,046	857
Reduction for Post 2000 ERP Projects	303	68
Remaining 5 Year Reductions Required	2,743	789
Calculated Reduction with DR Factor	5,063	1,326
Calculated Reduction with LU and Soil Reclassification	19,529	5,997
Calculated Reduction with North and Central Base Housing Treatment Credits	749	336
Total Reductions from Model Refinements	25,341	7,659

CCAFS COMPLIANCE STRATEGY

	TN (lb/yr)	TP (lb/yr)
FDEP Required 15 Year Reduction	20,938	6,320
FDEP Required 5 Year Reduction	3,141	948
Existing Industrial Area Project Credit	865	380
Predicted Reduction with DR Factor	8,631	927
Predicted Reduction with Soil Reclassification	6,171	842
Total Reduction from Model Adjustments	15,667	2,149

SEDIMENT REMOVAL OPERATIONS

STORMWATER SOLUTIONS SEDIMENT TRACKER DATABASE

IS YOUR COMMUNITY
RECEIVING NPDES MS4 AND
TMDL CREDITS FOR THEIR
SEDIMENT CLEANING
ACTIVITIES?

STORMWATER SOLUTIONS
HAS THE
ANSWER FOR YOU!

BY TRACKING YOUR PUBLIC
WORKS ACTIVITIES WITH OUR
UNIQUE SEDIMENT TRACKING
DATABASE, POLLUTANTS IN
SEDIMENTS CAN EASILY BE
CALCULATED AND REPORTED

USE OUR MICROSOFT ACCESS
DATABASE TO SCHEDULE, TRACK, AND
REPORT STREET SWEEPING, BMP
CLEANING, DITCH CLEANING, AND
PIPE CLEANING ACTIVITIES

BENEFITS:

- AUTOMATICALLY CALCULATES USER DEFINED POLLUTANT MASSES SUCH AS TSS, HEAVY METALS, TOTAL PHOSPHORUS AND TOTAL NITROGEN
- CALCULATED POLLUTANTS CAN BE USED TO OFFSET TMDL ALLOCATIONS AND REDUCE RETROFIT COSTS!
- SHOWS COMPLIANCE WITH NPDES MS4 REPORTING REQUIREMENTS
- EASY TO USE, INTUITIVE DATA ENTRY
- SCHEDULE AND RECORD MONTHLY SEDIMENT CLEANING ACTIVITIES
- END OF YEAR REPORT SUMMARIES



Street Sweeping Data Entry - S.W. Solutions, Inc.

Select Street Sweeping Name: Main Street

Select Maintenance Date: Date: March 06, 2009

Maintenance Data

Sediment Removed: 12 in Cubic Yards

Vegetation Removed: 1 in Cubic Yards

Miles Swept: 12

Contractor Name: Acme's Trucking

Comments:

Revised Date:

Main Menu Return To Street Menu Clear Fields Search Submit Exit



Pollutant Data Entry - Stormwater Solutions, Inc.

Select Pollutant: TP Cleaning Activity: PIPE CLEANING

Sediment Pollutant Concentration: 1274 in (mg/kg)

Sediment Density: 1 in (lb/cubic foot)

Vegetation Pollutant Concentration: 1001 in (mg/kg)

Vegetation Density: 1 in (lb/cubic foot)

Main Menu Return to Pollutant Menu Clear Data Submit Exit

Sediment Tracking Report

From: Saturday, March 22, 2008 To: Tuesday, March 17, 2009

Activity Name	Sediment Removed	Vegetation Removed
Street Sweeping (cy)	153.00	11.00
Pipe Cleaning (cy)	4.00	0.00
Ditch Cleaning (cy)	55.00	12.00
BMP Cleaning		
Inlet (cy)	27.50	27.00
Vault (cy)	0.00	0.00

Pollutant Name	Activity Name	Pollutant Concentration - Sediment (mg/kg)	Pollutant Concentration - Vegetation (mg/kg)	Pollutant Removed - Sediment (kg)	Pollutant Removed - Vegetation (kg)	Pollutant Total Removed (kg)
TH	Street Sweeping	5.00	2.00	0.63	0.00	0.63
	Ditch Cleaning	8.00	3.00	0.41	0.00	0.41
	BMP Cleaning	5.00	2.00	0.00	0.00	0.00
				1.04	0.00	1.04
TP	Pipe Cleaning	44.00	3.00	0.12	0.00	0.12
				0.12	0.00	0.12
Grand Total				1.16	0.00	1.16

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Sediment Tracking Report

Basin Name: Old Tampa Bay

From: 07/10/2008

To: 07/12/2009

SEDIMENT TRACKER

Activity Name		Sediment Removed	Vegetation Removed
Street Sweeping (cy)		41.000	3.000
Pipe Cleaning(cy)		64.000	469.000
Ditch Cleaning(cy)		102.000	25.000
BMP Cleaning	Inlet (lb)	922.000	959.000
	Vault (cy)	5.830	0.970

Activity Name		Sediment Density (lb/cf)	Vegetation Density (lb/cf)	Sediment Removed (lb)	Vegetation Removed (lb)
Street Sweeping		100.00	200.00	110,700.00	16,200.00
Pipe Cleaning		20.00	10.00	34,560.00	126,630.00
Ditch Cleaning		50.00	60.00	137,700.00	40,500.00
BMP Cleaning	Inlet	NA	NA	922.00	959.00
	Vault	20.00	200.00	3,150.00	5,250.00

Pollutant Name	Activity Name	Pollutant Concentration Sediment (mg/kg)	Pollutant Concentration Vegetation (mg/kg)	Pollutant Removed Sediment (kg)	Pollutant Removed Vegetation (kg)	Total Pollutant Removed (kg)
Hg						
	Street Sweeping	4,882.000	25.000	244.540	0.180	
				244.540	0.180	244.730
TN						
	Street Sweeping	12.000	25.000	0.600	0.180	
	Pipe Cleaning	87.000	22.000	1.360	1.260	
	Ditch Cleaning	808.000	222.000	50.340	4.070	
	BMP Inlet Cleaning	333.000	122.000	0.140	0.050	
				52.450	5.570	58.010

NEGOTIATION SCHEDULE

- **12 – 24 MONTHS, MAYBE MORE**
- **STATE POLITICS WILL DRIVE SCHEDULE AND COMPLIANCE**

INDIAN RIVER COALITION

- **CITIES AND BASES COMBINE RESOURCES AND FUNDS TO CREATE NEW TMDL OVER NEXT 2 - 3 YEARS**
- **REASSESS SEAGRASS**
- **DEVELOP NEW MODEL**

LESSONS LEARNED

- **CIVILIAN PROCESS**
- **TMDLS AND MODELS WILL BE DIFFERENT AT EVERY BASE**
- **BMPS WILL BE DIFFERENT FOR EVERY TMDL**
- **PROACTIVE PARTICIPATION IN RULEMAKING**
- **USE SPECIALTY TMDL CONSULTANT FOR CIVILIAN POLITICS AND RULEMAKING**