APPENDIX 38

APPENDIX 39

Nonattainment Diagnostics Part Deux

WQGIT 24 May 2010

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Analytical Diagnostics Team

Lewis Linker (EPA CBP)

Gary Shenk (EPA CBP)

Ping Wang (UMCES CBP)

Jeni Keisman (UMCES CBP)

Aaron Gorka (CRC CBP)

Michael Barnes (CRC CBP)

Sucharith Ravi (UMCES CBP)

Guido Yactayo (UMCES CBP)

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AR0037767

"Problem" Segments: Non-attaining at 170 TN

	Cbseg	1985 '93-'95	'91-'00 Base '93-'95	2007 Scenario '93-'95	Trib Stategy '93-'95	190 Load Scenario '93-'95	179 Load Scenario '93-'95	170 Load Scenario '93-'95	E3 2010 Scenario '93-'95	All Forest Scenario '93-'95
Open Water	CB7PH	8.8%	7.0%	2.2%	0.3%	0.2%	0.1%	0.1%	0.0%	0.0%
	GUNOH	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%
	MANMH	0.4%	0.6%	5.0%	5.0%	5.0%	5.0%	5.1%	5.1%	0.0%
	MDATF	34.3%	38.7%	34.5%	12.1%	12.1%	11.5%	11.3%	0.0%	0.0%
	MPCOH	33.1%	42.3%	32.3%	25.0%	17.9%	4.6%	4.6%	4.6%	0.0%
	PMKTF	11.0%	11.0%	4.6%	4.6%	4.6%	4.6%	2.3%	0.7%	0.7%
	SEVMH	20.5%	15.5%	9.0%	6.4%	5.8%	5.8%	5.8%	1.4%	0.0%
	VPCOH	32.5%	40.9%	32.3%	25.0%	17.9%	4.6%	4.6%	4.6%	0.0%
	WBEMH	15.3%	11.1%	15.3%	7.8%	7.8%	7.8%	7.8%	0.0%	0.0%
	WICMH	11.2%	11.2%	11.2%	4.6%	4.6%	4.6%	4.6%	4.6%	4.4%
	WSTMH	9.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
	YRKMH	17.6%	24.0%	6.6%	1.0%	0.8%	0.7%	0.4%	0.0%	0.0%
Deep Water	CB5MH	9.8%	6.9%	1.5%	0.3%	0.3%	0.1%	0.0%	0.0%	0.0%
	CHSMH	35.5%	24.7%	15.6%	1.8%	1.8%	1.6%	0.5%	0.4%	0.0%
	EASMH	25.4%	5.7%	1.4%	0.7%	0.7%	0.2%	0.2%	0.0%	0.0%
	MAGMH	34.8%	34.8%	34.8%	15.9%	3.4%	3.4%	0.5%	0.5%	0.0%
	MOSMH	11.8%	9.1%	4.2%	1.5%	1.3%	0.9%	0.6%	0.1%	0.0%
Deep Channel	CHSMH	38.0%	38.0%	29.4%	14.0%	13.7%	13.7%	9.4%	3.6%	0.0%
	EASMH	31.5%	26.1%	12.9%	2.3%	1.3%	0.3%	0.0%	0.0%	0.0%

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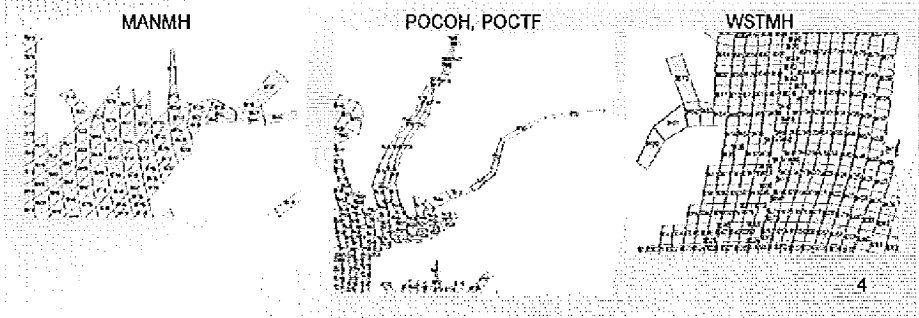
Open Water: General Findings

- 10 out of 12 OW problem segments are located in small tributaries represented by 1 or 2 WQSTM grid cells that overlap land, thus take load inputs directly
- Numerically, they represent 13% of Bay segments
- By volume, they represent about 1% of the Bay's Open Water



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Open Water: General Findings

Generally, non-attainment in any given segment results from 2 or more of the following factors:

(1) * Less-than-expected change in DO concentrations from calibration to E3 scenario;

(2) * Range of simulated DO concentrations well outside range of observed DO concentrations;

(3) Unusually and/or very low observed DO concentrations, which are very difficult to "scenario" into "Open Water" attainment under any conditions

* These factors likely result from limitations in the estuarine model's ability to integrate multiple drivers of DO concentrations in shallow, shore-adjacent cells.

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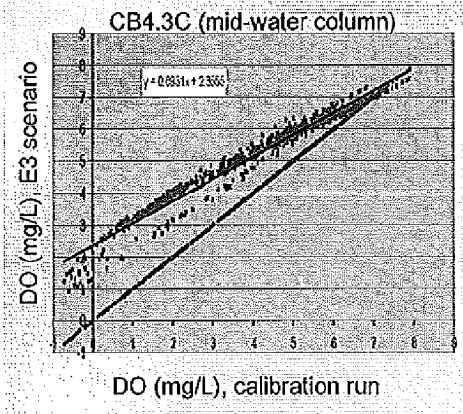
Open Water: General Findings

(1) Less-than-expected change in DO concentrations from calibration to E3 scenario

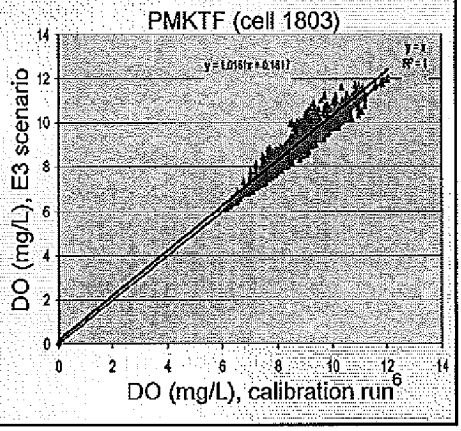
Load reductions reduce hypoxia:

CB4.3C (mid-water column)



Little response to load reductions:

PMKTF (cell 1803)



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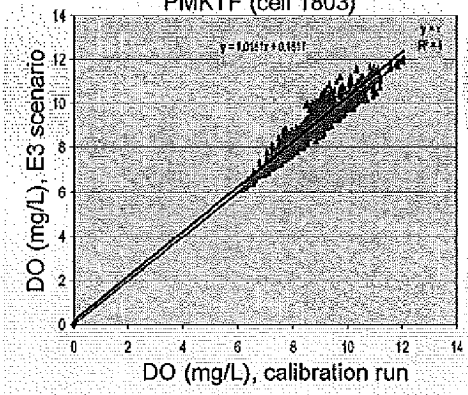
Open Water: General Findings

(1) Less-than-expected change in DO concentrations from calibration to E3 scenario

Little response to load reductions:

PMKTF (cell 1803)



- Observed almost universally in problem segments
- Not observed in all months
- When poor response occurs in month with measured violations, result is persistent non-attainment

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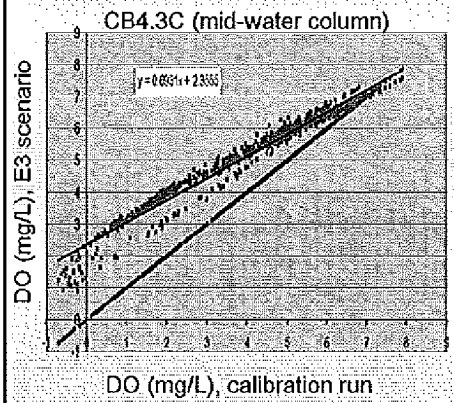
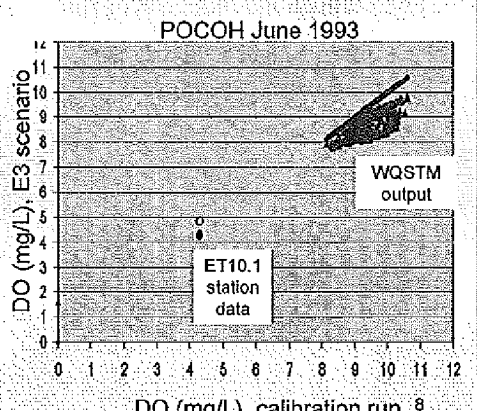
Open Water: General Findings

(2) Range of simulated DO concentrations well outside range of observed DO concentrations

CB4.3C (mid-water column)



POCOH June 1993



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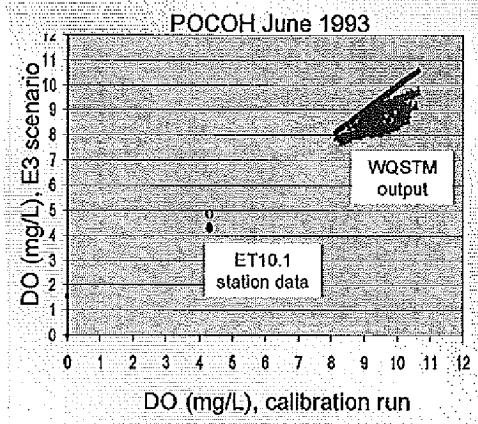
Open Water: General Findings

(2) Range of simulated DO concentrations well outside range of observed DO concentrations



- Observed almost universally in problem segments
  - Varying degrees of severity
- Shallow waters adjacent to land (thus direct watershed model inputs)
- Reduces confidence in ability of regression equation to effectively represent system's response to load reductions

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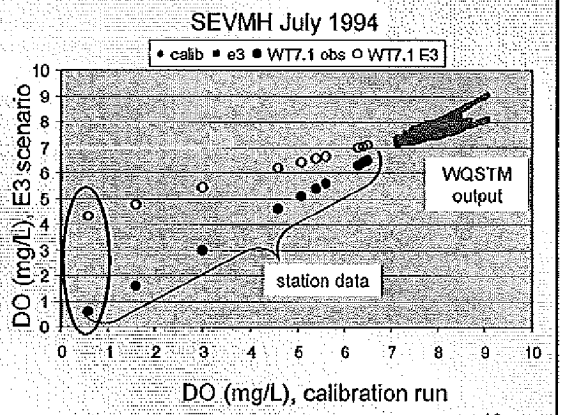
Open Water: General Findings

(3) Unusually and/or very low observed DO concentrations, which are very difficult to "scenario" into "Open Water" attainment under any conditions

		observed	E3
year	month	vio rate	vio rate
1993	6	25.9%	0.0%
1993	7	25.4%	25.4%
1993	8	14.0%	0.0%
1993	9	0.0%	0.0%
1994	6	25.4%	13.4%
1994	7	14.0%	0.7%
1994	8	14.0%	0.0%
1994	9	24.6%	0.0%
1995	6	40.0%	0.0%
1995	7	14.0%	0.0%
1995	8	57.5%	40.4%
1995	9	40.0%	12.0%



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Open Water: General Findings

Additional Lines of Evidence For Anticipated Response and Attainment

Cbseg
CB7PH
GUNOH
MANMH
MDATF
MPCOH
PMKTF
SEVMH
VPCOH
WBEMH
WICMH
WSTMH
YRKMH

1. Are violations isolated or persistent?
2. What is condition of nearby waters?
3. What is the estimated response to load reductions in nearby, deeper regions?

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Open Water "Problem" Segments

Summary Thus Far

Cbseg
CB7PH
GUNOH ✓
MANMH ✓
MDATF
MPCOH ✓
PMKTF ✓
SEVMH ?
VPCOH ✓
WBEMH
WICMH ✓
WSTMH ✓
YRKMH

- GUNOH: generally healthy DO conditions; 1 unusually low observation; poor regression behavior; nearby regions attain with moderate load reductions
- MANMH: few observed DO violations; poor simulation and regression behavior; most nearby segments attain by 170 Load scenario or sooner
- WICMH: single month prevents attainment at 170 TN; month shows marginal hypoxia (~4.4 mg/L) and poor estuarine model fit
- POCOH, POCTF: represented by same monitoring station and model cell. Single month (June 1993) prevents attainment at 170TN; month shows marginal hypoxia (4.3 mg/L) and poor estuarine model fit
- WSTMH: 2 months with unusually low bottom DO preventing attainment; values well outside range of simulations; nearby segments (e.g. RHDMH, CB4MH OW) attain
- SEVMH: substantial violations in observed data; substantial reduction in violations with load reductions; very low bottom DO values outside range of model simulations

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Open Water "Problem" Segments

Summary Thus Far

Cbseg
CB7PH ✓
GUNOH ✓
MANMH ✓
MDATF
MPCOH ✓
PMKTF ✓
SEVMH ?
VPCOH ✓
WBEMH
WICMH ✓
WSTMH ✓
YRKMH ✓

Open Water

- MDATF and WBEMH: small and/or narrow tributary locations which may be susceptible to similar limitations in estuarine model simulations and scenario regressions
- CB7PH and YRKMH: below 1% non-attainment at 170 TN

Cbseg	1985 '93-'95	'91-'00 Base '93-'95	2007 Scenario '93-'95	Trib Stategy '93-'95	190 Load Scenario '93-'95	179 Load Scenario '93-'95	170 Load Scenario '93-'95	E3 2010 Scenario '93-'95
CB7PH	8.8%	7.0%	2.2%	0.3%	0.2%	0.1%	0.1%	0.0%
GUNOH	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%
MANMH	0.4%	0.6%	5.0%	5.0%	5.0%	5.0%	5.1%	5.1%
MDATF	34.3%	38.7%	34.6%	12.1%	12.1%	11.5%	11.3%	0.0%
MPCOH	33.1%	42.3%	32.3%	25.0%	17.9%	4.6%	4.6%	4.6%
PMKTF	11.0%	11.0%	4.6%	4.6%	4.6%	4.6%	2.3%	0.7%
SEVMH	20.5%	15.5%	9.0%	6.4%	5.8%	5.8%	5.8%	1.4%
VPCOH	32.5%	40.9%	32.3%	25.0%	17.9%	4.6%	4.6%	4.6%
WBEMH	15.3%	11.1%	15.3%	7.8%	7.8%	7.8%	7.8%	0.0%
WICMH	11.2%	11.2%	11.2%	4.6%	4.6%	4.6%	4.6%	4.6%
WSTMH	9.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
YRKMH	17.6%	24.0%	6.6%	1.0%	0.8%	0.7%	0.4%	0.0%

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Open Water "Problem" Segments

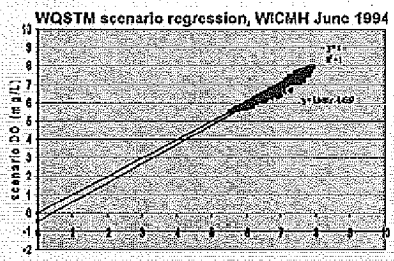
Summary Thus Far

WICMH:

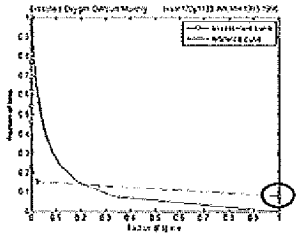
- moderate violations in observed data;
- Single month (June 1994) preventing attainment
- Observed hypoxia in June 1994 is marginal/moderate
- Poor estuarine model response (regression) for June 1994

WICMH		observed	170 TN
year	month	vio rate	vio rate
1993	6	0.0%	0.0%
1993	7	5.5%	1.9%
1993	8	0.0%	0.0%
1993	9	0.0%	0.0%
1994	6	100.0%	100.0%
1994	7	100.0%	0.0%
1994	8	0.0%	0.0%
1994	9	0.0%	0.0%
1995	6	0.0%	0.0%
1995	7	0.0%	0.0%
1995	8	0.0%	0.0%
1995	9	0.0%	0.0%

WQSTM scenario regression, WICMH June 1994



Assessment CFD, 170 Load Scenario



data

ET7.1	observed	170 TN
0.5	4.6	4.39
1	4.5	4.29
2	4.4	4.28
3	4.4	4.28
4	4.4	4.28
5	4.5	4.38
6	4.55	4.435

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Open Water "Problem" Segments

Summary Thus Far

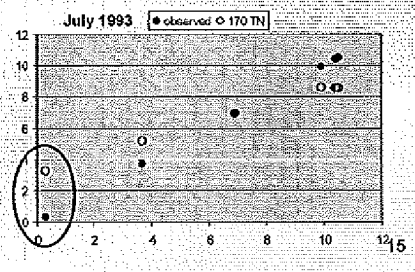
SEVMH:

- substantial violations in observed data;
- moderate reduction in violations with load reductions;
- very low bottom DO concentrations outside range of model simulations
- 6 out of 7 months with persistent violations have observed upper pycnocline boundaries

months with vios at 170 TN	upper pyc	lower pyc
Jul-93	y	n
Jun-94	y	n
Jul-94	n	n
Sep-94	y	y
Jun-95	y	n
Aug-95	y	n
Sep-95	y	y

Cbseg
CB7PH
GUNOH ✓
ANMH ✓
MDATF
MPCOH ✓
PMKTF ✓
SEVMH ?
VPCOH ✓
WBEMH
WICMH ✓
WSTMH ✓
YRKMH

SEVMH		observed	170 TN
year	month	vio rate	vio rate
1993	6	25.0%	0.0%
1993	7	25.4%	25.4%
1993	8	14.0%	0.0%
1993	9	0.0%	0.0%
1994	6	25.4%	25.4%
1994	7	14.0%	1.8%
1994	8	14.0%	0.0%
1994	9	24.6%	3.6%
1995	6	40.0%	4.8%
1995	7	14.0%	0.0%
1995	8	57.5%	57.5%
1995	9	40.0%	40.0%



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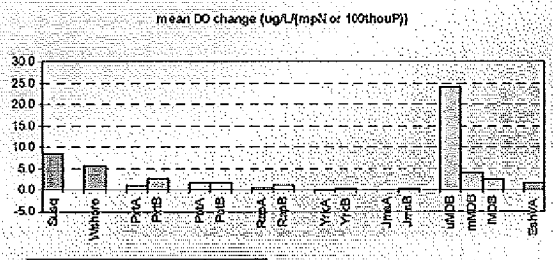
Deep Water/Deep Channel Segments

Preliminary Findings: CHSMH



CHSMH D/W		observed	E3
year	month	vio rate	vio rate
1993	6	74.0%	3.4%
1993	7	68.1%	45.7%
1993	8	54.1%	12.2%
1994	7	17.2%	7.5%
1994	8	4.1%	0.0%
1994	9	29.2%	9.9%
1995	7	100.0%	23.7%
1995	8	58.8%	13.1%
1995	9	0.0%	0.0%

CHSMH DC		observed	E3
year	month	vio rate	vio rate
1993	6	100.0%	0.0%
1993	7	100.0%	50.0%
1993	8	81.9%	22.2%
1993	8	0.0%	0.0%
1994	7	14.1%	0.0%
1994	9	0.0%	0.0%
1995	8	100.0%	0.0%
1995	9	0.0%	0.0%

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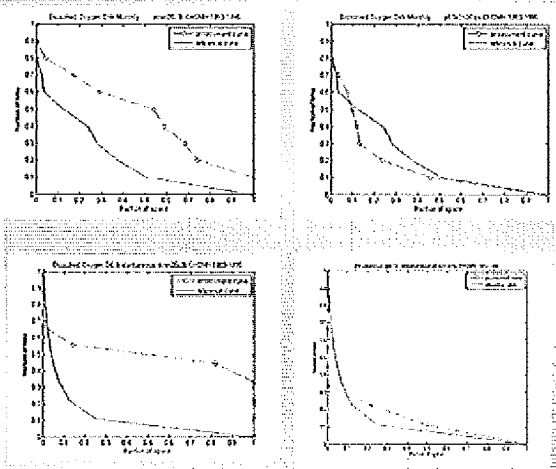
Deep Water/Deep Channel Segments

Preliminary Findings: CHSMH



	upper pyc	lower pyc
1993_6_1	3.5	10.5
1993_6_2	5.5	nd
1993_7_1	7.5	9.5
1993_7_2	5.5	nd
1993_8_1	4.5	12.5
1993_8_2	7.5	8.5
1993_9_1	nd	
1993_9_2	nd	
1994_6_1	nd	
1994_6_2	nd	
1994_7_1	6.5	11.5
1994_7_2	nd	
1994_8_1	nd	
1994_8_2	4	nd
1994_9_1	4.5	nd
1994_9_2	2.5	5.5
1995_6_1	nd	
1995_6_2	nd	
1995_7_1	nd	
1995_7_2	10.5	nd
1995_8_1	nd	
1995_8_2	7.5	9.5
1995_9_1	1.5	10.5
1995_9_2	nd	

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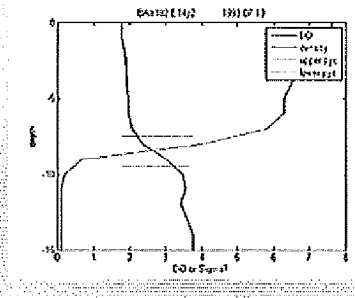
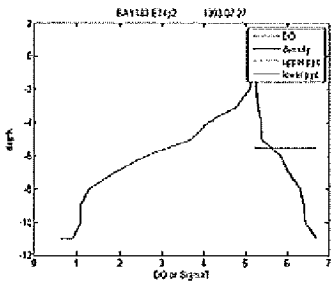
Deep Water/Deep Channel Segments

Preliminary Findings: CHSMH

July 13, 1993



July 27, 1993



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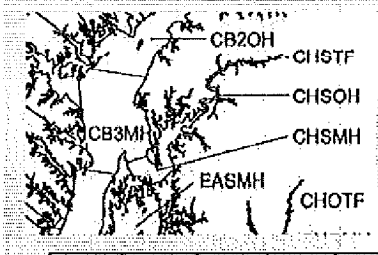
Deep Water/Deep Channel Segments

Preliminary Findings: CHSMH



Cbseg	1985 Scenario '93-'95 DO Deep Water	'91-'94 Base '93-'95 DO Deep Water	2007 Scenario '93-'95 DO Deep Water	Tributary Strategy '93-'95 DO Deep Water	150 Loading Scenario '93-'95 DO Deep Water	170 Loading Scenario '93-'95 DO Deep Water	170 Loading Scenario '93-'95 DO Deep Water	E3 2010 Scenario '93-'95 DO Deep Water	All Forest Scenario '93-'95 DO Deep Water
CHSMH	35.5%	24.7%	15.6%	1.8%	1.8%	1.6%	0.5%	0.4%	0.0%
CB3MH	2.6%	2.0%	0.6%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%

Cbseg	DO Deep Channel	DO Deep Channel	DO Deep Channel	DO Deep Channel	DO Deep Channel	DO Deep Channel	DO Deep Channel	DO Deep Channel	DO Deep Channel
CHSOH	38.0%	38.0%	29.4%	14.0%	13.7%	13.7%	9.4%	3.6%	0.0%
CB3MH	17.9%	14.5%	6.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%

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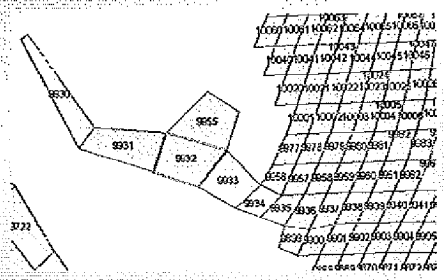
Deep Water/Deep Channel Segments

Preliminary Findings: MAGMH



Deep Water/Deep Channel Segments

Preliminary Findings: MAGMH

Violations

MAGMH		observed	170 TN
year	month	vio rate	vio rate
1993	6	44.9%	0.0%
1994	9	44.9%	0.0%
1995	7	100.0%	0.0%
1995	8	0.0%	0.0%
1995	9	100.0%	44.9%

July 1995

	observed	170 TN
depth	DO (mg/L)	DO (mg/L)
0.5	7.1	7.15
1	7.1	7.15
2	6.9	6.45
3	5.3	5.9
4	0.6	4.28
5	0.4	4.21

Sept 1995

WT6.1	observed	170 TN
depth	DO (mg/L)	DO (mg/L)
0.5	6	6.32
1	5.7	6.11
2	3.8	4.75
3	0.3	2.06
4	0.85	2.485

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Deep Water/Deep Channel Segments

Preliminary Findings

		1995	'91-'00 Base	2007 Scenario	Trib Stategy	190 Load Scenario	179 Load Scenario	170 Load Scenario
	Cbseg	'93-'95	'93-'95	'93-'95	'93-'95	'93-'95	'93-'95	'93-'95
Deep Water	CBSMH	9.8%	6.9%	1.5%	0.3%	0.3%	0.1%	0.0%
	CHSMH	35.5%	24.7%	15.6%	1.8%	1.8%	1.6%	0.5%
	EASMH	25.4%	5.7%	1.4%	0.7%	0.7%	0.2%	0.2%
	MAGMH	34.8%	34.8%	34.8%	15.9%	3.4%	3.4%	0.5%
	MDSMH	11.8%	9.1%	4.2%	1.5%	1.3%	0.9%	0.6%
Deep Channel	CHSMH	38.0%	38.0%	29.4%	14.0%	13.7%	13.7%	9.4%
	EASMH	31.5%	26.1%	12.9%	2.3%	1.3%	0.3%	0.0%

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