Why Has Attainment Changed?

1. It looks like Open Water non-attainment has gotten worse. Why?

2. Some segments aren't responding to reduced loads, or are getting worse. Why?

Multiple Interacting Effects:

1. Episodic pycnoclines
2. Moved critical period from 1996-8 to 1993-5
3. Moved from P5.2 to P5.3 watershed model

Background

Segments With Existing Deep Water & Deep Channel Designated Uses:

Deep Water:

CB3MH

CB4MH

CB5MH

CB6PH (portion north of UTM Y 4145)

CB7PH (portion N/NW of UTM Y = UTM X + 3752745)

CHSMH

EASMH

PATMH

PAXMH

POTMH

RPPMH (portion S of UTM Y = 4185000)

SBEMH

YRKPH

Deep Channel:

CB3MH

CB4MH

CB5MH

CHSMH

EASMH

PATMH

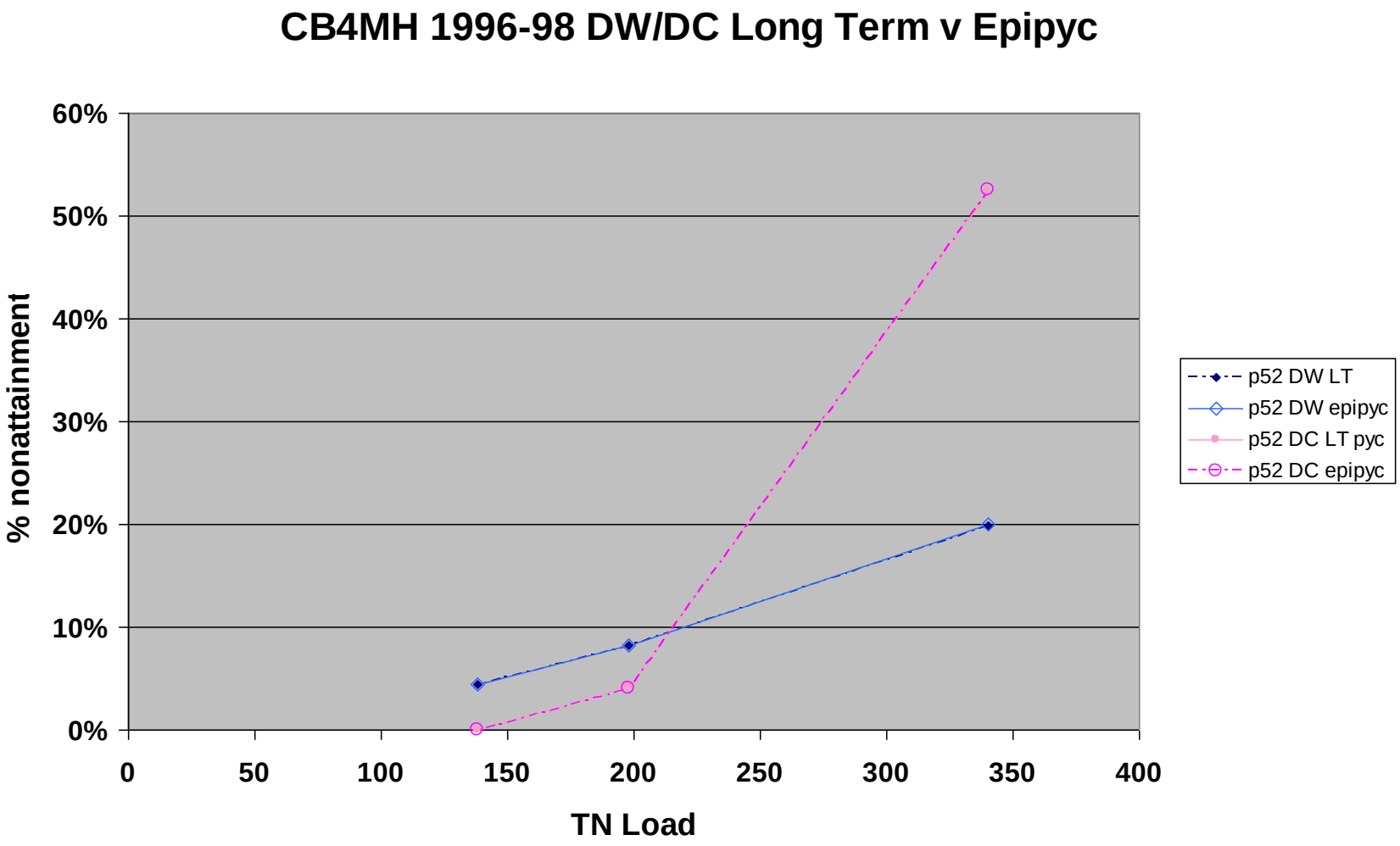
POTMH

RPPMH (portion S of UTM Y = 4185000 & upstream of line where UTM_Y – 1.49(UTM_X) ≥ 3621199.172)

From EPA 903-R-03-002: Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and chlorophyll *a* for the Chesapeake Bay And Its Tidal Tributaries (April 2003) and

EPA 903-R-04-006: Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability: 2004 Addendum (October 2004)

Effect of episodic pycnoclines (phase 5.2)



Pycnocline Method: "Episodic-Only" v. "Episodic + Long-Term Average"

Effects On TMDL Scenario Assessments: 1996-1998 Open Water Summer

1996-1998 Open Waer Summer	**Scenario→**	**91 -'00 Base Scenario, 340TN 24.1TP**	**Target Load Scenario Option 3 198TN 14.8TP**	**E3 2010 Scenario, 138TN 12.0TP**		**91 -'00 Base Scenario, 340TN 24.1TP**	**Target Load Scenario Option 3 198TN 14.8TP**	**E3 2010 Scenario, 138TN 12.0TP**
		published DW & DC du's				DU's per pycnocline		
CB3MH	MD	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
CB4MH	MD	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
CB5MH	both	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
CB6PH	VA	0.9%	0.0%	0.0%		1.1%	0.0%	0.0%
CB7PH	VA	4.3%	0.0%	0.0%		4.4%	0.0%	0.0%
CHSMH	MD	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
EASMH	MD	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
MD5MH	MD	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
PATMH	MD	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
PAXMH	MD	4.7%	0.0%	0.0%		3.9%	0.0%	0.0%
POMMH	MD	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
POTMH	both	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
POVMH	VA	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
RPPMH	VA	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
SBEMH	VA	25.0%	0.0%	0.0%		23.8%	0.0%	0.0%
VA5MH	VA	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
YRKPH	VA	6.9%	0.0%	0.0%		8.1%	0.0%	0.0%

Pycnocline Method: "Episodic-Only" v. "Episodic + Long-Term Average"

Effects On TMDL Scenario Assessments: 1996-1998 Deep Water Summer

1996-1998 Deep Waer Summer	Scenario →	91 -'00 Base Scenario, 340TN 24.1TP	Target Load Scenario Option 3 198TN 14.8TP	E3 2010 Scenario, 138TN 12.0TP		91 -'00 Base Scenario, 340TN 24.1TP	Target Load Scenario Option 3 198TN 14.8TP	E3 2010 Scenario, 138TN 12.0TP
		published DW & DC du's				DU's per pycnocline		
CB3MH	MD	1.9%	0.3%	0.0%		3.4%	0.9%	0.5%
CB4MH	MD	19.9%	8.2%	4.4%		20.0%	8.2%	4.5%
CB5MH	both	5.6%	0.4%	0.0%		5.8%	0.4%	0.0%
CB6PH	VA	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
CB7PH	VA	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
CHSMH	MD	0.0%	0.0%	0.0%		2.2%	0.2%	0.4%
EASMH	MD	1.9%	0.0%	0.1%		8.6%	1.3%	1.0%
MD5MH	MD	9.5%	1.2%	0.0%		9.7%	1.2%	0.0%
PATMH	MD	5.5%	0.0%	0.0%		7.7%	0.0%	0.0%
PAXMH	MD	1.8%	0.0%	0.0%		1.1%	0.0%	0.0%
POMMH	MD	6.3%	0.0%	0.0%		6.7%	0.0%	0.0%
POTMH	both	6.2%	0.0%	0.0%		6.6%	0.0%	0.0%
POVMH	VA	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
RPPMH	VA	7.0%	0.0%	0.0%		7.3%	0.0%	0.0%
SBEMH	VA	0.0%	0.0%	0.0%		0.0%	NoData	NoData
VA5MH	VA	0.3%	0.0%	0.0%		0.7%	0.0%	0.0%
YRKPH	VA	1.1%	0.0%	0.0%		2.0%	0.0%	0.0%

Pycnocline Method: "Episodic-Only" v. "Episodic + Long-Term Average"

Effects On TMDL Scenario Assessments: 1996-1998 Deep Channel Summer

1996-1998 Deep Channel Summer	Scenario →	91 -'00 Base Scenario, 340TN 24.1TP	Target Load Scenario Option 3 198TN 14.8TP	E3 2010 Scenario, 138TN 12.0TP		91 -'00 Base Scenario, 340TN 24.1TP	Target Load Scenario Option 3 198TN 14.8TP	E3 2010 Scenario, 138TN 12.0TP
		published DW & DC du's				DU's per pycnocline		
CB3MH	MD	6.8%	0.6%	0.0%		13.3%	2.9%	0.0%
CB4MH	MD	52.2%	4.2%	0.0%		52.6%	4.1%	0.0%
CB5MH	both	17.6%	0.0%	0.0%		18.9%	0.0%	0.0%
CB6PH	VA	N/A	N/A	N/A		0.0%	0.0%	0.0%
CB7PH	VA	N/A	N/A	N/A		0.0%	0.0%	0.0%
CHSMH	MD	0.0%	1.9%	0.7%		5.6%	8.1%	4.2%
EASMH	MD	22.4%	4.7%	0.1%		29.3%	6.4%	0.5%
MD5MH	MD	28.5%	0.0%	0.0%		29.1%	0.0%	0.0%
PATMH	MD	16.2%	0.0%	0.0%		19.8%	0.0%	0.0%
PAXMH	MD	N/A	N/A	N/A		7.6%	0.0%	0.0%
POMMH	MD	18.9%	0.0%	0.0%		21.1%	0.0%	0.0%
POTMH	both	18.8%	0.0%	0.0%		20.9%	0.0%	0.0%
POVMH	VA	NoData	NoData	NoData		NoData	NoData	NoData
RPPMH	VA	18.2%	0.0%	0.0%		22.8%	0.0%	0.0%
SBEMH	VA	N/A	N/A	N/A		NoData	NoData	NoData
VA5MH	VA	2.4%	0.0%	0.0%		2.5%	0.0%	0.0%
YRKPH	VA	N/A	N/A	N/A		0.0%	0.0%	0.0%

Pycnocline Method: "Episodic-Only" v. "Episodic + Long-Term Average"

Effects On TMDL Scenario Assessments: 1993-1995 Deep Water Summer

Cbseg	Scenario→ / Year→ / State	91-'00 Base Scenario, 340TN 24.1TP '93-'95 DO Deep Water	Target Load Scenario Option 3 198TN 14.8TP '93-'95 DO Deep Water	E3 2010 Scenario, 138TN 12.0TP '93-'95 DO Deep Water		91-'00 Base Scenario, 340TN 24.1TP '93-'95 DO Deep Water	Target Load Scenario Option 3 198TN 14.8TP '93-'95 DO Deep Water	E3 2010 Scenario, 138TN 12.0TP '93-'95 DO Deep Water
		published DW & DC du's				DU's per pycnocline		
CB3MH	MD	2.5%	0.1%	0.0%		3.4%	0.2%	0.0%
CB4MH	MD	19.4%	5.2%	1.5%		21.0%	5.7%	1.7%
CB5MH	both	4.9%	0.0%	0.0%		11.6%	0.0%	0.0%
CB6PH	VA	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
CB7PH	VA	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
CHSMH	MD	1.8%	0.0%	0.0%		25.1%	8.7%	2.2%
EASMH	MD	1.5%	0.0%	0.0%		7.3%	1.0%	0.5%
MD5MH	MD	9.9%	0.2%	0.0%		14.0%	0.1%	0.0%
PATMH	MD	5.0%	0.0%	0.0%		13.2%	0.9%	0.0%
PAXMH	MD	9.2%	0.0%	0.0%		6.6%	0.0%	0.0%
POMMH	MD	6.4%	0.0%	0.0%		6.5%	0.0%	0.0%
POTMH	both	6.4%	0.0%	0.0%		6.4%	0.0%	0.0%
POVMH	VA	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%
RPPMH	VA	11.6%	0.0%	0.0%		12.5%	0.0%	0.0%
VA5MH	VA	0.0%	0.0%	0.0%		9.6%	0.0%	0.0%
YRKPH	VA	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%

Pycnocline Method: “Episodic-Only” 1996-8 versus 1993-5

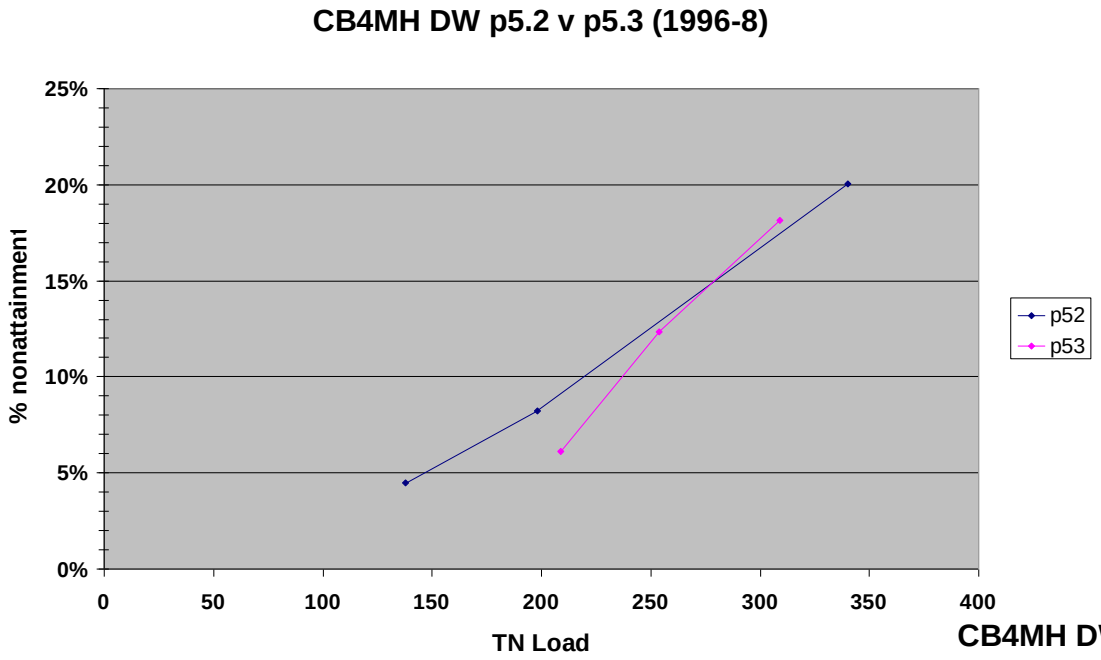
Effects On CHSMH Deep Water Summer

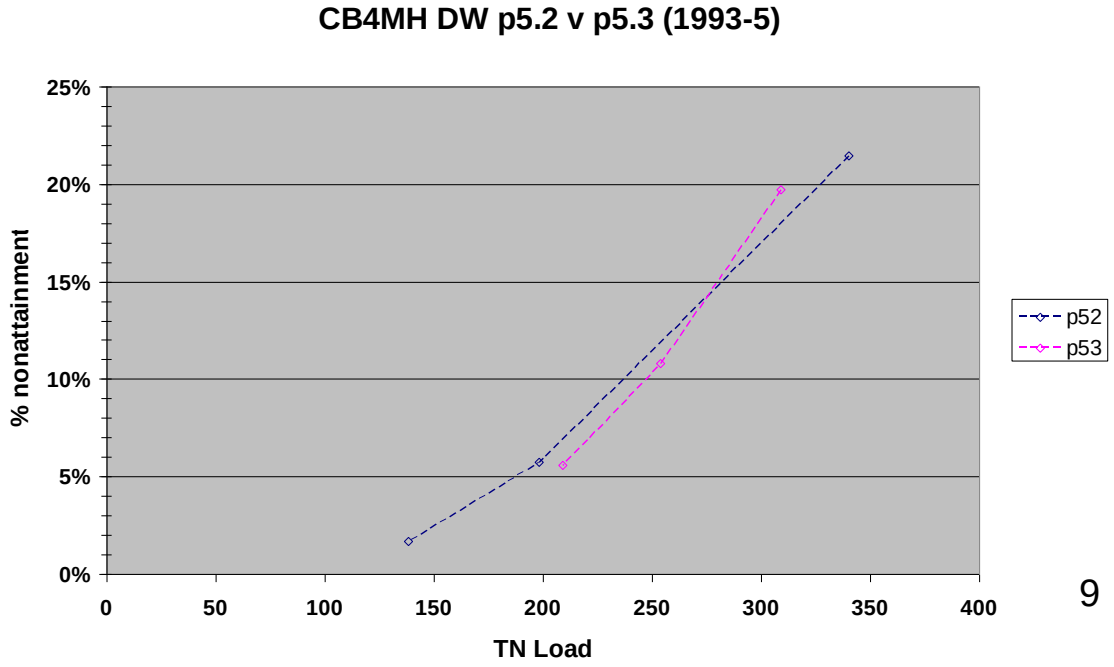
month	upper pyc depth		month	upper pyc depth
Jun-93	4.5		Jun-96	9.5
Jul-93	6.5		Jul-96	8
Aug-93	6		Aug-96	1.5
Sep-93	no pyc		Sep-96	1.5
Jun-94	no pyc		Jun-97	4
Jul-94	6.5		Jul-97	14.5
Aug-94	4		Aug-97	2.5
Sep-94	3.5		Sep-97	9.5
Jun-95	no pyc		Jun-98	1.5
Jul-95	10.5		Jul-98	4.5
Aug-95	7.5		Aug-98	no pyc
Sep-95	1.5		Sep-98	4.5

1996-8: no pycnocline detected for 1 out of 12 possible months

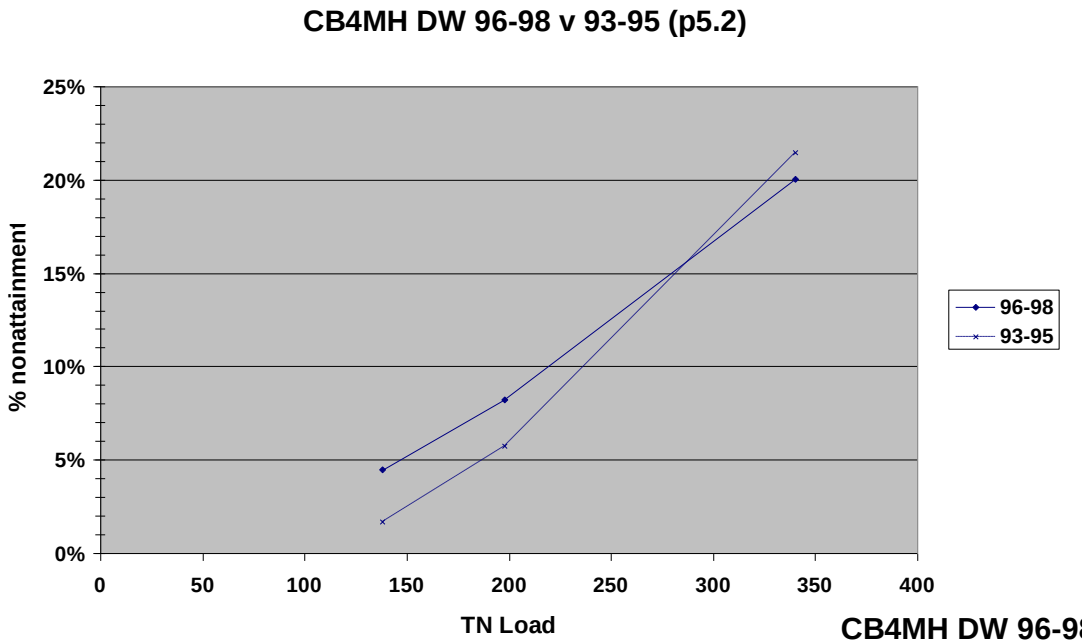
1993-5: no pycnocline detected for 3 out of 12 possible months

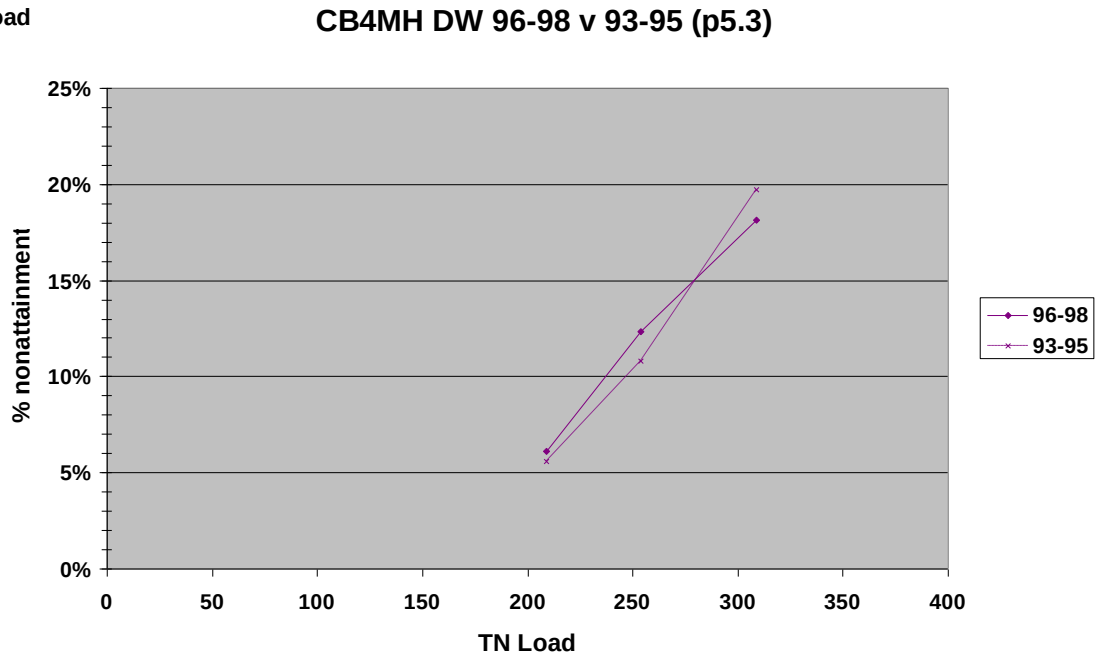
Effect of move from phase 5.2 to phase 5.3 watershed model





Effect of move from 1996-98 to 1993-5 critical period





Open Water Summer: Segments with worse results

1. Move from 1996-8 to 1993-5
2. P53 versus P52

WORSE	91-'00 Base (P53) 309TN 19.5 TP '96-'98	2007 Scenario (P53) 254 TN 17.1 TP '96-'98	Load Scenario (P53) 209 TN 13.8 TP '96-'98	91-'00 Base (P53) 309TN 19.5 TP '93-'95	2007 Scenario (P53) 254 TN 17.1 TP '93-'95	Load Scenario (P53) 209 TN 13.8 TP '93-'95		Intermediate B Scenario (P51) 279TN 17.2TP '96-'98	Intermediate A Scenario (P51) 209TN 13.7TP '96-'98	E3 2010 Scenario (P51), 138TN 12.0TP '96-'98	Intermediate B Scenario (P51) 279TN 17.2TP '93-'95	Intermediate A Scenario (P51) 209TN 13.7TP '93-'95	E3 2010 Scenario (P51), 138TN 12.0TP '93-'95
BOHOH	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CHSTF	0.6%	0.6%	0.0%	0.0%	0.1%	0.5%		0.0%	2.4%	1.4%	0.9%	10.1%	9.1%
CRRMH	9.6%	0.3%	0.0%	24.5%	3.9%	1.9%		1.5%	0.0%	0.0%	0.5%	0.0%	0.0%
DCATF	14.0%	10.9%	3.9%	27.5%	21.4%	5.4%		2.8%	1.5%	0.0%	6.8%	3.9%	0.0%
DCPTF	0.0%	0.0%	0.0%	0.6%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
EBEMH	17.7%	6.4%	1.9%	22.7%	21.5%	4.7%		0.0%	0.0%	0.0%	No Data	No Data	No Data
ELIPH	1.5%	0.0%	0.0%	4.3%	0.2%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
GUNOH	0.0%	0.0%	0.0%	4.6%	4.6%	4.6%		0.0%	0.0%	0.0%	4.6%	4.6%	4.6%
MANMH	0.0%	0.0%	3.5%	0.6%	5.0%	7.3%		0.0%	0.0%	0.0%	0.7%	0.8%	0.8%
MDATF	23.0%	21.2%	9.1%	38.7%	35.1%	14.7%		3.7%	2.4%	0.0%	19.7%	19.9%	6.9%
MIDOH	0.0%	0.0%	0.0%	0.0%	0.4%	4.5%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MOBPH	0.0%	0.0%	0.0%	0.7%	0.2%	0.0%		0.0%	0.0%	0.0%	0.2%	0.0%	0.0%
NANMH	0.0%	0.0%	0.0%	0.0%	0.0%	0.7%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PAXOH	11.6%	1.8%	0.0%	19.6%	2.9%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PAXTF	0.0%	0.0%	0.0%	9.0%	6.0%	0.0%		0.0%	0.0%	0.0%	1.4%	0.0%	0.0%
PIAMH	0.0%	0.0%	0.0%	0.1%	2.6%	3.3%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PMKTF	4.6%	4.6%	4.6%	11.0%	11.6%	12.3%		No Data	No Data	No Data	0.0%	0.0%	0.0%
SASOH	2.0%	0.3%	0.0%	7.9%	2.2%	0.5%		2.0%	0.0%	0.0%	1.1%	0.0%	0.0%
SBEMH	28.0%	12.2%	2.8%	35.2%	17.3%	6.1%		0.0%	0.0%	0.0%	No Data	No Data	No Data
SEVMH	7.3%	9.2%	6.8%	15.5%	18.8%	9.0%		2.3%	0.0%	0.0%	5.6%	0.0%	0.0%
WBEMH	0.8%	0.0%	0.0%	11.1%	15.3%	7.8%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
WSTMH	0.4%	0.4%	0.4%	0.5%	19.0%	16.5%		0.0%	0.0%	0.0%	0.5%	0.0%	0.0%

Take Home:

For mainstem and mid-bay in particular, effects of moving from P52 to P53 and from 1993-1995 were small

For some other segments, the combined effects of these 2 changes resulted in higher non-attainment

How we can track down causes:

Segment-by-Segment Drill-Down: MANMH

MANMH stations:	ET8.1

MANMH 1993-1995 violations:	year	month	violation rate
	1993	6	0
	1993	7	0.4489796
	1993	8	0
	1993	9	0
	1994	6	0
	1994	7	0
	1994	8	0
	1994	9	0
	1995	6	0.148688
	1995	7	1
	1995	8	0
	1995	9	0

ET8.1 p53 input data	utm x	utm y	sample depth	DO (mg/L)	station name
	428467	4221862	0.5	6	ET8.1
	428467	4221862	1	5.8	ET8.1
	428467	4221862	2	5.7	ET8.1
	428467	4221862	3	5.2	ET8.1
	428467	4221862	4	5.1	ET8.1

p53 load scenario data	utm x	utm y	sample depth	DO (mg/L)	station name
	428467	4221862	0.5	5.12	ET8.1
	428467	4221862	1	4.8	ET8.1
	428467	4221862	2	4.64	ET8.1
	428467	4221862	3	3.84	ET8.1
	428467	4221862	4	3.68	ET8.1

	cell	m	b	r2
p53 calib - to - p53 loading scenario regression for cell 6705:	6705	1.60E+00	-4.47E+00	8.56E-01

value = value * m + b
5.12 = (6*1.6)-4.47

p53 base:						p53_alc_apr					
year	month	day	hour	cell	DO (mg/L)	year	month	day	hour	cell	DO (mg/L)
1993	7	1	1	6705	6.046	1993	7	1	1	6705	4.798
1993	7	1	2	6705	6.101	1993	7	1	2	6705	4.847
1993	7	1	3	6705	6.127	1993	7	1	3	6705	4.77
1993	7	1	4	6705	6.135	1993	7	1	4	6705	4.708
1993	7	1	5	6705	6.164	1993	7	1	5	6705	4.748
1993	7	1	6	6705	6.236	1993	7	1	6	6705	4.909
1993	7	1	7	6705	6.334	1993	7	1	7	6705	5.148
1993	7	1	8	6705	6.428	1993	7	1	8	6705	5.366
1993	7	1	9	6705	6.531	1993	7	1	9	6705	5.475
1993	7	1	10	6705	6.61	1993	7	1	10	6705	5.599
1993	7	1	11	6705	6.683	1993	7	1	11	6705	5.745
1993	7	1	12	6705	6.761	1993	7	1	12	6705	5.896
1993	7	1	13	6705	6.835	1993	7	1	13	6705	6.022
1993	7	1	14	6705	6.891	1993	7	1	14	6705	6.088
1993	7	1	15	6705	6.897	1993	7	1	15	6705	6.019
1993	7	1	16	6705	6.818	1993	7	1	16	6705	5.819
1993	7	1	17	6705	6.73	1993	7	1	17	6705	5.628
1993	7	1	18	6705	6.696	1993	7	1	18	6705	5.556
1993	7	1	19	6705	6.686	1993	7	1	19	6705	5.521
1993	7	1	20	6705	6.666	1993	7	1	20	6705	5.452
1993	7	1	21	6705	6.64	1993	7	1	21	6705	5.363
1993	7	1	22	6705	6.593	1993	7	1	22	6705	5.24
1993	7	1	23	6705	6.57	1993	7	1	23	6705	5.19
1993	7	1	24	6705	6.566	1993	7	1	24	6705	5.212

Next Steps:

1. Examine segment-level TN and TP inputs to each segment
2. Examine cell-level inputs to each segment
3. Examine “scenario’ing” method to confirm that it works as expected in all cases