Preliminary Attainment Results of CBP Scoping Scenarios (using 2005-2013 loadings) run through the VIMS Eutrophication Model

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VADEQ-Office of Ecology
Modeling Workgroup Quarterly Review
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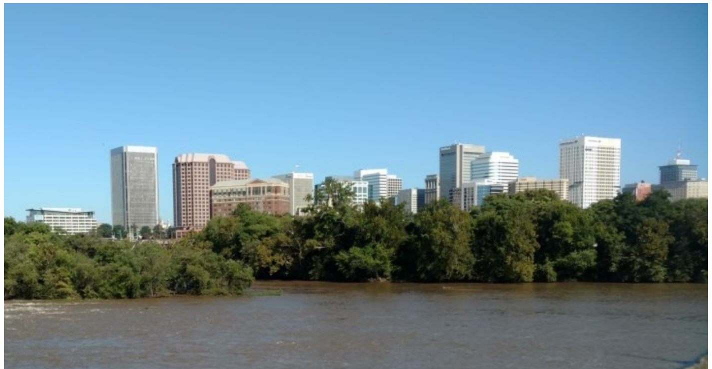
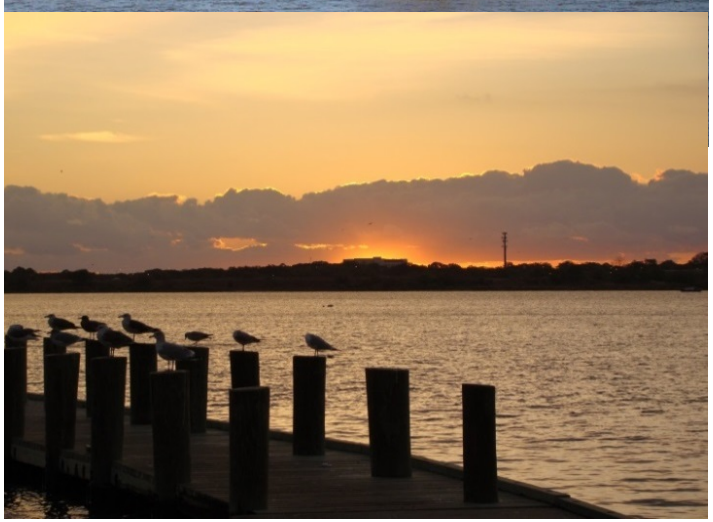
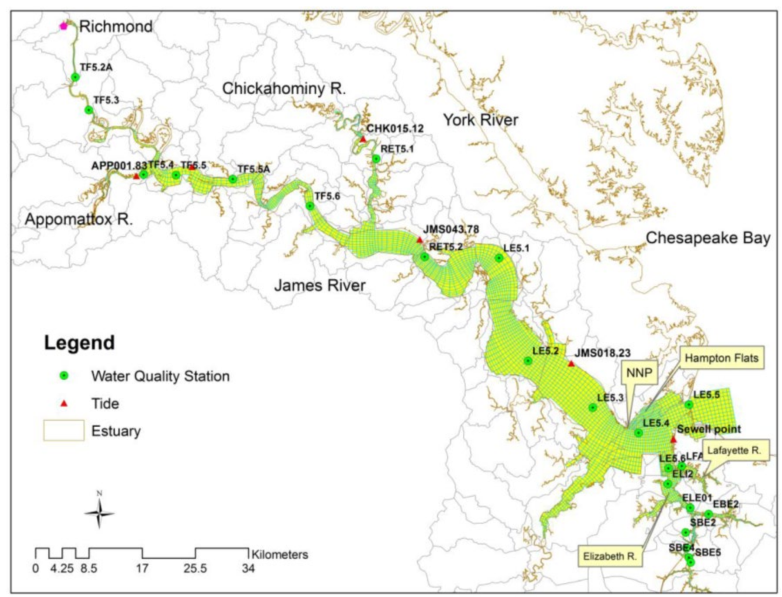




VADEQ has…

- developed an alternative set of chlorophyll-a criteria for the James River estuary.
- developed an alternative assessment methodology for James R. chlorophyll-a criteria.
- contracted with VIMS to develop a water quality model specific to the James River that will help inform management decisions.



Current Seasonal Mean Criteria

Allowable frequency = 10% CFD

bb. The following site specific numerical chlorophyll a criteria apply March 1 through May 31 and July 1 through September 30 as seasonal means to the tidal James River (excludes tributaries) segments JMSTF2, JMSTF1, JMSOH, JMSMH, JMSPH and are implemented in accordance with subsection D of 9VAC25-260-185.

Designated Use	Chlorophyll a µ/l	Chesapeake Bay Program Segment	Temporal Application
Open Water	10	JMSTF2	March 1 - May 31
	15	JMSTF1	
	15	JMSOH	
	12	JMSMH	
	12	JMSPH	
	15	JMSTF2	July 1 - September 30
	23	JMSTF1	
	22	JMSOH	
	10	JMSMH	
	10	JMSPH	

Current Seasonal Mean Criteria

Allowable frequency = 10% CFD

bb. The following site specific numerical chlorophyll a criteria apply March 1 through May 31 and July 1 through September 30 as seasonal means to the tidal James River (excludes tributaries) segments JMSTF2, JMSTF1, JMSOH, JMSMH, JMSPH and are implemented in accordance with subsection D of 9VAC25-260-185.

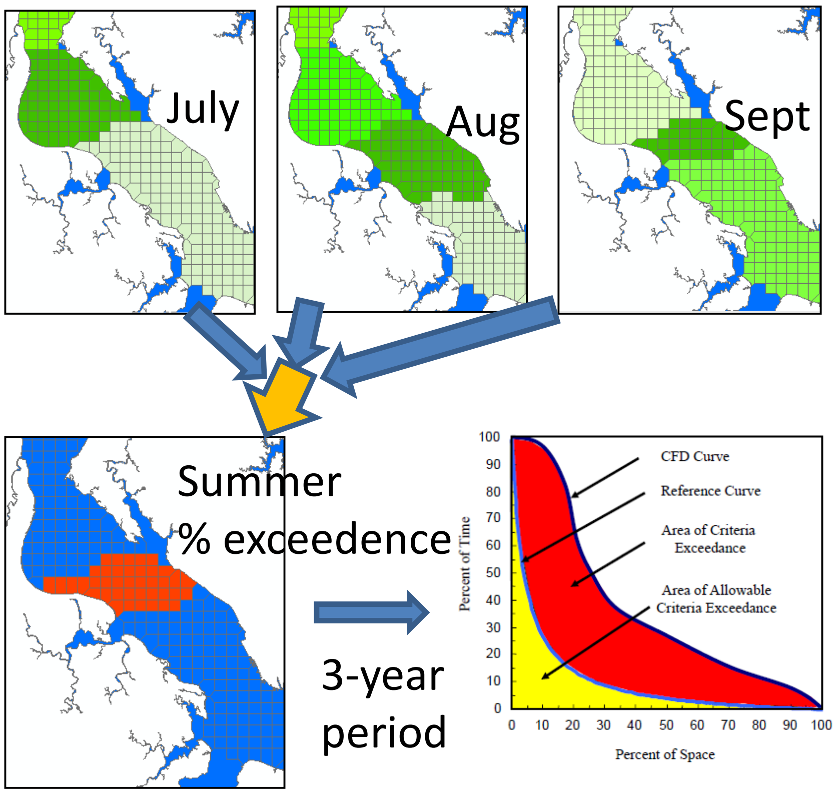
Designated Use	Chlorophyll a µ/l	Chesapeake Bay Program Segment	Temporal Application
Open Water	10	JMSTF2	March 1 - May 31
	15	JMSTF1	
	15	JMSOH	
	12	JMSMH	
	12	JMSPH	
	15	JMSTF2	July 1 - September 30
	23	JMSTF1	
	22	JMSOH	
	10	JMSMH	
	10	JMSPH	

Proposed Seasonal Mean Criteria

Allowable frequency = No more than two exceedences in six years

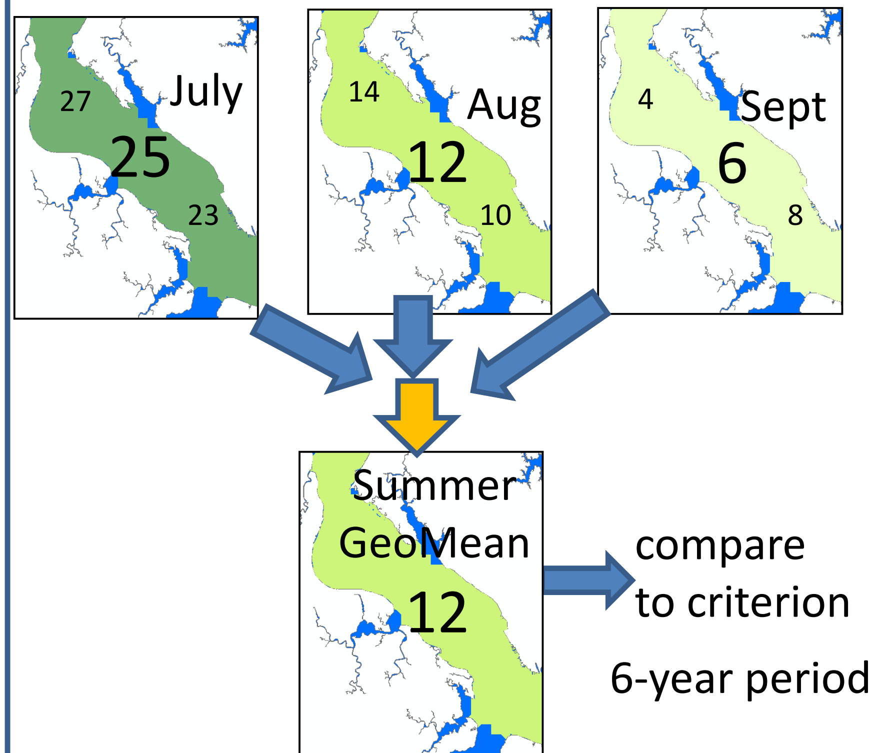
Designated Use	Chlorophyll-*a* µg/l	Chesapeake Bay Program Segment	Temporal Application
Open water	8	JMSTF2	March 1 - May 31 (spring)
	10	JMSTF1	
	13	JMSOH	
	7	JMSMH	
	8	JMSPH	
	21	JMSTF2	July 1 - September 30 (summer)
	24	JMSTF1	
	11	JMSOH	
	7	JMSMH	
	7	JMSPH	

How is the proposed assessment method different from the current one?



Samples are interpolated to a grid for each cruise, then seasonal means are calculated for each cell and assessed against the criterion. Spatial exceedence % calculated.

Current



Samples pooled within segment for each cruise, then cruise composites are averaged over each season and assessed against the criterion.

Proposed

VADEQ has made an **important** addition to its proposal!

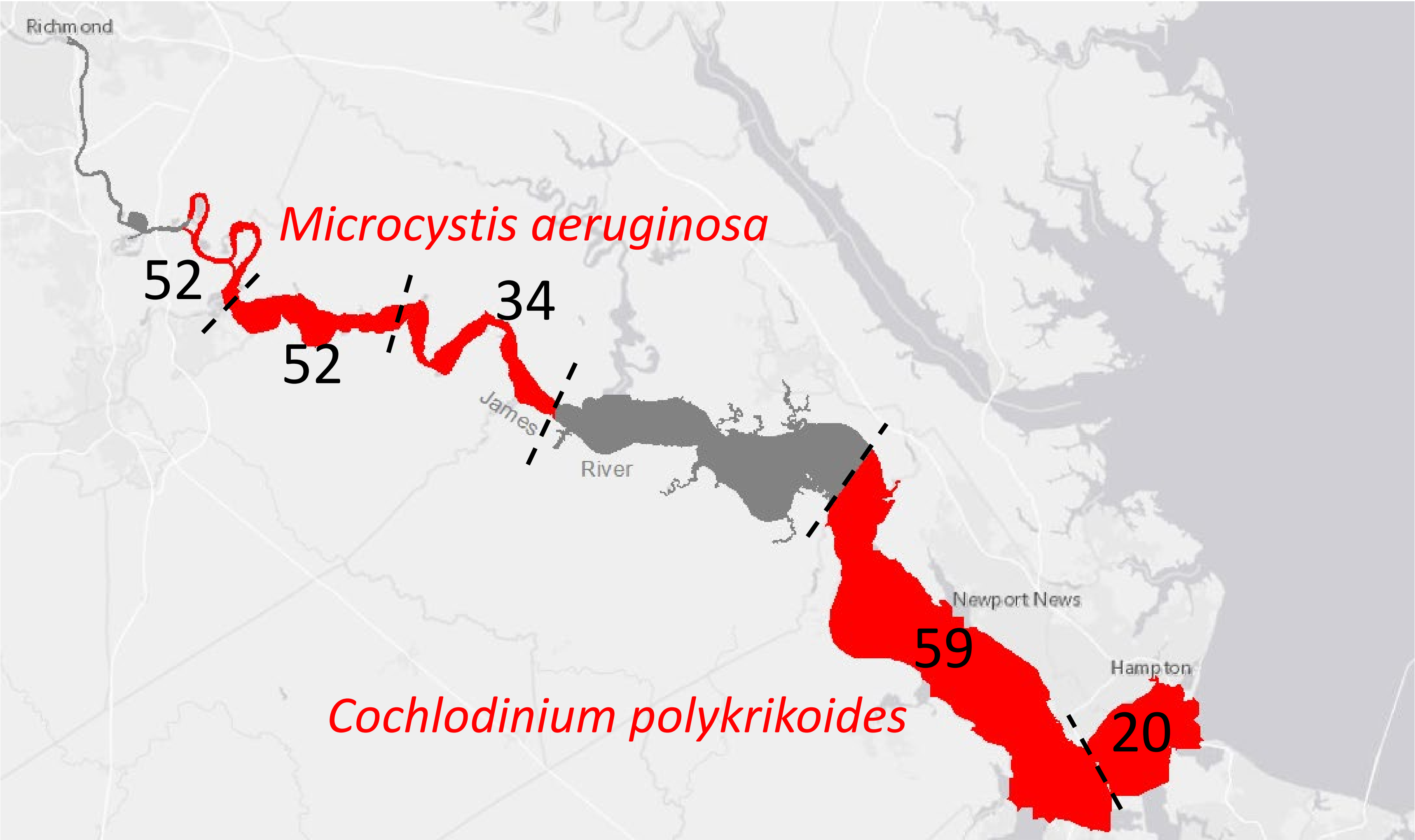
NEW STUFF!

In addition to seasonal mean criteria, VADEQ is proposing short-duration criteria for specific areas of the estuary where HABs have been documented. Both sets of criteria would have to be met for the segment to be in compliance with the WQS.

Chlorophyll-*a* µg/l	Chesapeake Bay Program Segment	Spatial Application	Duration
52	JMSTF2	River mile 95 to downstream boundary of JMSTF2	1-Month median
52	JMSTF1	Upstream boundary of JMSTF1 to river mile 67	1-Month median
34	JMSTF1	River mile 67 to downstream boundary of JMSTF1	1-Month median
--	JMSOH	Entire segment	--
59	JMSMH	Entire segment	1-Day median
20	JMSPH	Entire segment	1-Day median

Allowable frequency = No more than 10% of the time over six years

Specific areas where short-duration criteria apply (in red)



At the last Modeling Workgroup meeting…

VADEQ expressed its desired for the 2005-2013 scenario loadings estimated by the Bay Watershed Model.

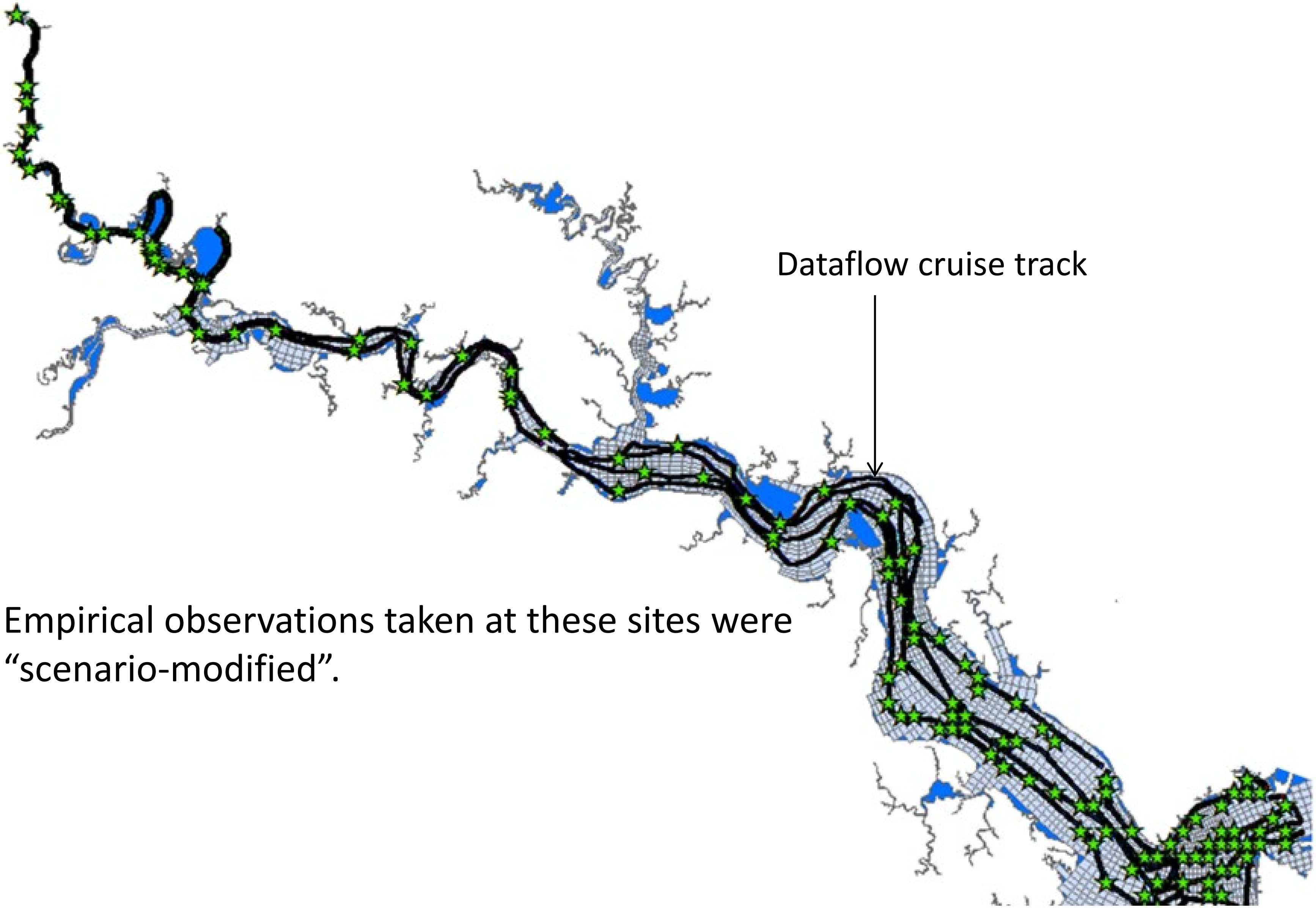
<u>Justification for using 2005-2013 loadings:</u>

- The 2005-2013 monitoring data were used to derive the alternative criteria.

- The 2005-2013 monitoring datasets are much more spatially and temporally intensive than the 1991-2000 datasets. Scenario-modifying the former produces more confident determinations of "attainability" than the latter.

The James River modeling team has successfully shifted its focus to the 2005-2013 period.

- 2005-2013 loadings
- 2005-2013 observations (fixed station and Dataflow) for "scenario-modification"



Empirical observations taken at these sites were "scenario-modified".

The following CBP scenarios that have been run through the VIMS eutrophication model:

- 2013 Progress
- 2017 Progress
- DO Attainment
- WIP2
- E3

Assessment Results Under Each Load Reduction Scenario

Summary of Assessment Results

	Current Criteria	Proposed Seasonal Mean Criteria	Proposed Short-Duration Criteria
Observed 2005-2013			
2013 Scenario			
2017 Scenario			
DO			
WIP2			
E3			

Attainment

Non-attainment

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Assessment Results using Empirical Data (2005-2013)

Current Criteria, Current Assessment Procedure (CFD)

SPRING		**Baseline**			
period	**JMSTFU**	**JMSTFL**	**JMSOH**	**JMSMH**	**JMSPH**
2005-2007	0.0	0.0	0.0	1.4	21.8
2006-2008	0.0	0.0	0.0	0.0	0.0
2007-2009	0.0	0.0	10.1	0.0	0.0
2008-2010	0.0	0.0	10.1	0.0	2.4
2009-2011	0.0	0.0	10.1	0.0	2.4
2010-2012	0.0	8.0	0.0	0.0	2.4
2011-2013	0.0	8.0	0.0	2.8	0.0
SUMMER		**Baseline**			
period	**JMSTFU**	**JMSTFL**	**JMSOH**	**JMSMH**	**JMSPH**
2005-2007	10.0	2.0	0.0	0.0	10.5
2006-2008	3.5	0.4	0.0	4.2	1.5
2007-2009	26.2	10.3	0.0	8.8	5.6
2008-2010	41.3	24.5	0.0	12.4	5.8
2009-2011	51.9	45.9	0.0	5.7	1.7
2010-2012	37.7	52.5	0.0	0.9	0.0
2011-2013	19.1	52.6	0.0	0.0	0.0

Values are excessive space-time exceedence rates (%)
Red values indicate non-attainment.

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Assessment Results using Empirical Data (2005-2013)

Current Criteria, Current Assessment Procedure

SPRING		Baseline			
period	**JMSTFU**	**JMSTFL**	**JMSOH**	**JMSMH**	**JMSPH**
2005-2007	0.0	0.0	0.0	1.4	21.8
2006-2008	0.0	0.0	0.0	0.0	0.0
2007-2009	0.0	0.0	10.1	0.0	0.0
2008-2010	0.0	0.0	10.1	0.0	2.4
2009-2011	0.0	0.0	10.1	0.0	2.4
2010-2012	0.0	8.0	0.0	0.0	2.4
2011-2013	0.0	8.0	0.0	2.8	0.0
SUMMER		**Baseline**			
period	**JMSTFU**	**JMSTFL**	**JMSOH**	**JMSMH**	**JMSPH**
2005-2007	10.0	2.0	0.0	0.0	10.5
2006-2008	3.5	0.4	0.0	4.2	1.5
2007-2009	26.2	10.3	0.0	8.8	5.6
2008-2010	41.3	24.5	0.0	12.4	5.8
2009-2011	51.9	45.9	0.0	5.7	1.7
2010-2012	37.7	52.5	0.0	0.9	0.0
2011-2013	19.1	52.6	0.0	0.0	0.0

Values are excessive space-time exceedence rates (%)
Red values indicate non-attainment.

Proposed Criteria, Proposed Assessment Procedure

SPRING	Baseline				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	2	5	10	**8**	**11**
2006	7	8	10	6	5
2007	5	6	4	4	7
2008	4	4	7	6	5
2009	7	7	**23**	6	6
2010	4	4	7	5	**10**
2011	7	8	6	4	6
2012	**10**	**13**	2	5	4
2013	5	5	5	**8**	5
SUMMER	Baseline				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	14	14	10	**10**	**9**
2006	9	11	8	6	6
2007	8	12	3	5	7
2008	12	15	8	**9**	**8**
2009	**26**	22	7	6	**8**
2010	**30**	**25**	10	4	3
2011	20	**33**	7	4	4
2012	15	**29**	2	3	**8**
2013	20	22	5	4	6

Values are observed chlorophyll seasonal means (ug/l).
Red values indicate exceedences of proposed criteria.
Red boxes indicate six-year periods of non-attainment.

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Assessment Results using Empirical Data (2005-2013)

Current Criteria, Current Assessment Procedure (CFD)

SPRING		Baseline			
period	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005-2007	0.0	0.0	0.0	1.4	21.8
2006-2008	0.0	0.0	0.0	0.0	0.0
2007-2009	0.0	0.0	10.1	0.0	0.0
2008-2010	0.0	0.0	10.1	0.0	2.4
2009-2011	0.0	0.0	10.1	0.0	2.4
2010-2012	0.0	8.0	0.0	0.0	2.4
2011-2013	0.0	8.0	0.0	2.8	0.0
SUMMER		**Baseline**			
period	**JMSTFU**	**JMSTFL**	**JMSOH**	**JMSMH**	**JMSPH**
2005-2007	10.0	2.0	0.0	0.0	10.5
2006-2008	3.5	0.4	0.0	4.2	1.5
2007-2009	26.2	10.3	0.0	8.8	5.6
2008-2010	41.3	24.5	0.0	12.4	5.8
2009-2011	51.9	45.9	0.0	5.7	1.7
2010-2012	37.7	52.5	0.0	0.9	0.0
2011-2013	19.1	52.6	0.0	0.0	0.0

Proposed Criteria, Proposed Assessment Procedure

SPRING	Baseline				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	2	5	10	8	11
2006	7	8	10	6	5
2007	5	6	4	4	7
2008	4	4	7	6	5
2009	7	7	23	6	6
2010	4	4	7	5	10
2011	7	8	6	4	6
2012	10	13	2	5	4
2013	5	5	5	8	5
SUMMER	Baseline				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	14	14	10	10	9
2006	9	11	8	6	6
2007	8	12	3	5	7
2008	12	15	8	9	8
2009	26	22	7	6	8
2010	30	25	10	4	3
2011	20	33	7	4	4
2012	15	29	2	3	8
2013	20	22	5	4	6

Proposed Short-Duration Criteria Proposed Assessment Method

SUMMER		Baseline			
Period	lower JMSTFU	upper JMSTFL	lower JMSTFL	JMSMH	JMSPH
2005-2010	0%	0%	0%	0%	6%
2006-2011	0%	12%	0%	0%	6%
2007-2012	0%	12%	0%	0%	10%
2008-2013	0%	12%	0%	0%	9%

Values are exceedence rates of the applicable short-duration criterion. Values greater than 10% are highlighted in red.

Current Criteria, Current Assessment Procedure

Values are excessive space-time exceedence rates%

Red indicates periods in non-attainment

Observed

SPRING	Baseline				
period	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005-2007	0.0	0.0	0.0	1.4	21.8
2006-2008	0.0	0.0	0.0	0.0	0.0
2007-2009	0.0	0.0	10.1	0.0	0.0
2008-2010	0.0	0.0	10.1	0.0	2.4
2009-2011	0.0	0.0	10.1	0.0	2.4
2010-2012	0.0	8.0	0.0	0.0	2.4
2011-2013	0.0	8.0	0.0	2.8	0.0

SUMMER	Baseline				
period	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005-2007	10.0	2.0	0.0	0.0	10.5
2006-2008	3.5	0.4	0.0	4.2	1.5
2007-2009	26.2	10.3	0.0	8.8	5.6
2008-2010	41.3	24.5	0.0	12.4	5.8
2009-2011	51.9	45.9	0.0	5.7	1.7
2010-2012	37.7	52.5	0.0	0.9	0.0
2011-2013	19.1	52.6	0.0	0.0	0.0

E3

SPRING	E3				
period	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005-2007	0.0	0.0	0.0	0.7	21.8
2006-2008	0.0	0.0	0.0	0.0	0.0
2007-2009	0.0	0.0	0.0	0.0	0.0
2008-2010	0.0	0.0	0.0	0.0	0.0
2009-2011	0.0	0.0	0.0	0.0	0.0
2010-2012	0.0	0.0	0.0	0.0	0.0
2011-2013	0.0	0.0	0.0	0.0	0.0

SUMMER	E3				
period	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005-2007	0.0	0.0	0.0	0.0	10.5
2006-2008	0.0	0.0	0.0	0.0	0.0
2007-2009	0.0	1.2	0.0	0.0	0.0
2008-2010	0.0	4.7	0.0	0.0	0.0
2009-2011	1.2	17.4	0.0	0.0	0.0
2010-2012	1.2	14.8	0.0	0.0	0.0
2011-2013	0.4	10.7	0.0	0.0	0.0

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non-attainment

non-attainment

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Proposed Criteria, Proposed Assessment Procedure

2013 Progress

Predicted seasonal means (ug/l)
(red values are exceedences of proposed criteria)

SPRING	2013 Progress				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	1	3	7	7	**11**
2006	3	4	8	5	4
2007	2	4	4	4	6
2008	1	3	5	5	6
2009	5	5	**16**	5	7
2010	4	4	6	5	**10**
2011	5	7	5	3	6
2012	**9**	11	2	4	4
2013	5	6	5	7	5

SUMMER	2013 Progress				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	9	12	7	**8**	**8**
2006	5	8	6	5	6
2007	5	10	3	4	6
2008	6	13	6	7	**8**
2009	20	20	5	5	7
2010	21	20	8	3	3
2011	20	**32**	6	4	4
2012	13	**28**	2	3	**8**
2013	19	21	4	4	6

attainment

Predicted exceedence frequencies of short-duration criteria
(red values are greater than allowable 10%)

SUMMER	2013 Progress				
Period	lower JMSTFU	upper JMSTFL	lower JMSTFL	JMSMH	JMSPH
2005-2010	0%	0%	0%	0%	5%
2006-2011	0%	**12%**	0%	0%	5%
2007-2012	0%	**12%**	0%	0%	8%
2008-2013	0%	**12%**	0%	0%	8%

non-attainment

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Proposed Criteria, Proposed Assessment Procedure

2013 Progress

Predicted seasonal means (ug/l)
(red values are exceedences of proposed criteria)

SPRING	2013 Progress				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	1	3	7	7	**11**
2006	3	4	8	5	4
2007	2	4	4	4	6
2008	1	3	5	5	6
2009	5	5	**16**	5	7
2010	4	4	6	5	**10**
2011	5	7	5	3	6
2012	**9**	11	2	4	4
2013	5	6	5	7	5
SUMMER	2013 Progress				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	9	12	7	**8**	**8**
2006	5	8	6	5	6
2007	5	10	3	4	6
2008	6	13	6	7	**8**
2009	20	20	5	5	7
2010	21	20	8	3	3
2011	20	**32**	6	4	4
2012	13	**28**	2	3	**8**
2013	19	21	4	4	6

attainment

Predicted exceedence frequencies of short-duration criteria
(red values are greater than allowable 10%)

SUMMER	2013 Progress				
Period	lower JMSTFU	upper JMSTFL	lower JMSTFL	JMSMH	JMSPH
2005-2010	0%	0%	0%	0%	5%
2006-2011	0%	**12%**	0%	0%	5%
2007-2012	0%	**12%**	0%	0%	8%
2008-2013	0%	**12%**	0%	0%	8%

non-attainment

2017 Progress

Predicted seasonal means (ug/l)
(red values are exceedences of proposed criteria)

SPRING	2017 Progress				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	1	3	7	6	**10**
2006	3	4	8	4	4
2007	2	4	3	4	6
2008	1	3	5	4	5
2009	4	5	**16**	5	7
2010	3	3	6	4	**9**
2011	5	6	5	3	5
2012	**9**	11	2	4	4
2013	4	5	4	7	5
SUMMER	2017 Progress				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	8	12	7	7	7
2006	4	8	6	5	5
2007	4	9	2	3	5
2008	5	12	6	6	7
2009	21	20	4	4	6
2010	18	17	7	3	3
2011	18	**29**	6	3	4
2012	12	**26**	2	3	7
2013	18	20	4	4	5

attainment

Predicted exceedence frequencies of short-duration criteria
(red values are greater than allowable 10%)

SUMMER	2017 Progress				
Period	lower JMSTFU	upper JMSTFL	lower JMSTFL	JMSMH	JMSPH
2005-2010	0%	0%	0%	0%	5%
2006-2011	0%	6%	0%	0%	5%
2007-2012	0%	6%	0%	0%	6%
2008-2013	0%	6%	0%	0%	7%

attainment

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Proposed Criteria, Proposed Assessment Procedure

2017 Progress

Predicted seasonal means (ug/l)
(red values are exceedences of proposed criteria)

SPRING	2017 Progress				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	1	3	7	6	**10**
2006	3	4	8	4	4
2007	2	4	3	4	6
2008	1	3	5	4	5
2009	4	5	**16**	5	7
2010	3	3	6	4	**9**
2011	5	6	5	3	5
2012	**9**	11	2	4	4
2013	4	5	4	7	5
SUMMER	**2017 Progress**				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	8	12	7	7	7
2006	4	8	6	5	5
2007	4	9	2	3	5
2008	5	12	6	6	7
2009	21	20	4	4	6
2010	18	17	7	3	3
2011	18	**29**	6	3	4
2012	12	**26**	2	3	7
2013	18	20	4	4	5

☺ attainment

Predicted exceedence frequencies of short-duration criteria
(red values are greater than allowable 10%)

SUMMER		2017 Progress			
Period	lower JMSTFU	upper JMSTFL	lower JMSTFL	JMSMH	JMSPH
2005-2010	0%	0%	0%	0%	5%
2006-2011	0%	6%	0%	0%	5%
2007-2012	0%	6%	0%	0%	6%
2008-2013	0%	6%	0%	0%	7%

☺ attainment

DO Attainment

Predicted seasonal means (ug/l)
(red values are exceedences of proposed criteria)

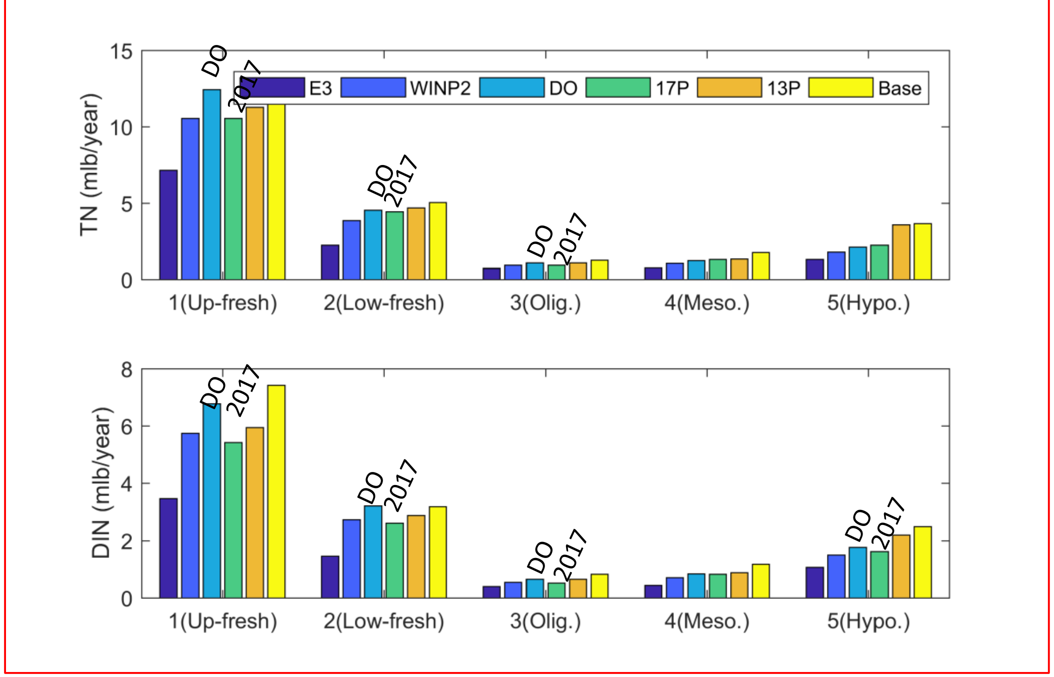
SPRING	DO Attainment				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	1	4	7	7	**9**
2006	4	6	8	4	3
2007	2	4	3	4	5
2008	2	3	6	5	5
2009	5	5	**18**	5	5
2010	4	4	6	5	8
2011	5	7	5	3	4
2012	**9**	**12**	3	4	3
2013	5	6	5	7	4
SUMMER	**DO Attainment**				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	8	12	8	7	7
2006	4	8	6	5	5
2007	5	15	3	3	5
2008	6	14	7	6	6
2009	19	19	6	4	6
2010	**22**	22	9	3	3
2011	19	**32**	6	4	4
2012	13	**29**	2	3	7
2013	18	20	3	4	5

☺ attainment

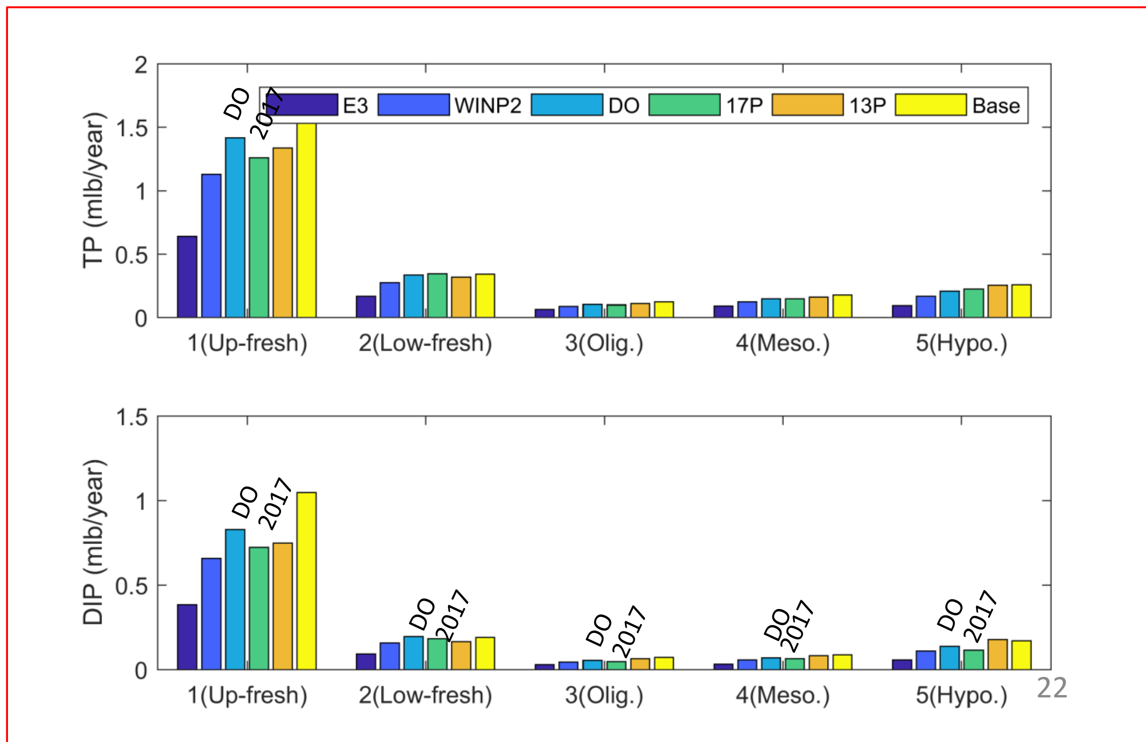
Predicted exceedence frequencies of short-duration criteria
(red values are greater than allowable 10%)

SUMMER		DO Attainment			
Period	lower JMSTFU	upper JMSTFL	lower JMSTFL	JMSMH	JMSPH
2005-2010	0%	0%	0%	0%	5%
2006-2011	0%	**12%**	0%	0%	5%
2007-2012	0%	**12%**	0%	0%	6%
2008-2013	0%	**12%**	0%	0%	7%

☹ non-attainment



Loads were slightly higher under the DO Attainment scenario than the 2017 Progress scenario, especially in the tidal fresh.



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Proposed Criteria, Proposed Assessment Procedure

DO Attainment

Predicted seasonal means (ug/l)
(red values are exceedences of proposed criteria)

SPRING	DO Attainment				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	1	4	7	7	**9**
2006	4	6	8	4	3
2007	2	4	3	4	5
2008	2	3	6	5	5
2009	5	5	**18**	5	5
2010	4	4	6	5	8
2011	5	7	5	3	4
2012	**9**	**12**	3	4	3
2013	5	6	5	7	4
SUMMER	**DO Attainment**				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	8	12	8	7	7
2006	4	8	6	5	5
2007	5	15	3	3	5
2008	6	14	7	6	6
2009	19	19	6	4	6
2010	**22**	22	9	3	3
2011	19	**32**	6	4	4
2012	13	**29**	2	3	7
2013	18	20	3	4	5

attainment

Predicted exceedence frequencies of short-duration criteria
(red values are greater than allowable 10%)

SUMMER		DO Attainment			
Period	lower JMSTFU	upper JMSTFL	lower JMSTFL	JMSMH	JMSPH
2005-2010	0%	0%	0%	0%	5%
2006-2011	0%	**12%**	0%	0%	5%
2007-2012	0%	**12%**	0%	0%	6%
2008-2013	0%	**12%**	0%	0%	7%

non-attainment

WIP2

Predicted seasonal means (ug/l)
(red values are exceedences of proposed criteria)

SPRING	WIP2				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	1	3	7	6	8
2006	3	5	8	4	3
2007	2	4	3	3	5
2008	2	3	5	4	5
2009	5	5	**15**	5	6
2010	4	3	5	4	8
2011	5	6	4	3	4
2012	8	11	2	4	3
2013	4	5	4	6	4
SUMMER	**WIP2**				
Year	JMSTFU	JMSTFL	JMSOH	JMSMH	JMSPH
2005	8	11	7	6	6
2006	4	7	6	4	5
2007	5	11	2	3	4
2008	6	12	6	5	6
2009	18	17	5	4	5
2010	20	19	7	2	2
2011	17	**29**	5	3	4
2012	11	**26**	1	2	7
2013	15	17	3	3	5

attainment

Predicted exceedence frequencies of short-duration criteria
(red values are greater than allowable 10%)

SUMMER		WIP2			
Period	lower JMSTFU	upper JMSTFL	lower JMSTFL	JMSMH	JMSPH
2005-2010	0%	0%	0%	0%	4%
2006-2011	0%	6%	0%	0%	4%
2007-2012	0%	6%	0%	0%	5%
2008-2013	0%	6%	0%	0%	5%

attainment

Summary of Assessment Results

	Current Criteria	Proposed Seasonal Mean Criteria	Proposed Short-Duration Criteria
Observed 2005-2013			
2013 Scenario			
2017 Scenario			
DO			
WIP2			
E3			

Attainment

Non-attainment

Questions?