Overview of the Finalized Oyster BMP Crediting Report

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CBP Sustainable Fisheries GIT Summer Meeting

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Panel Members

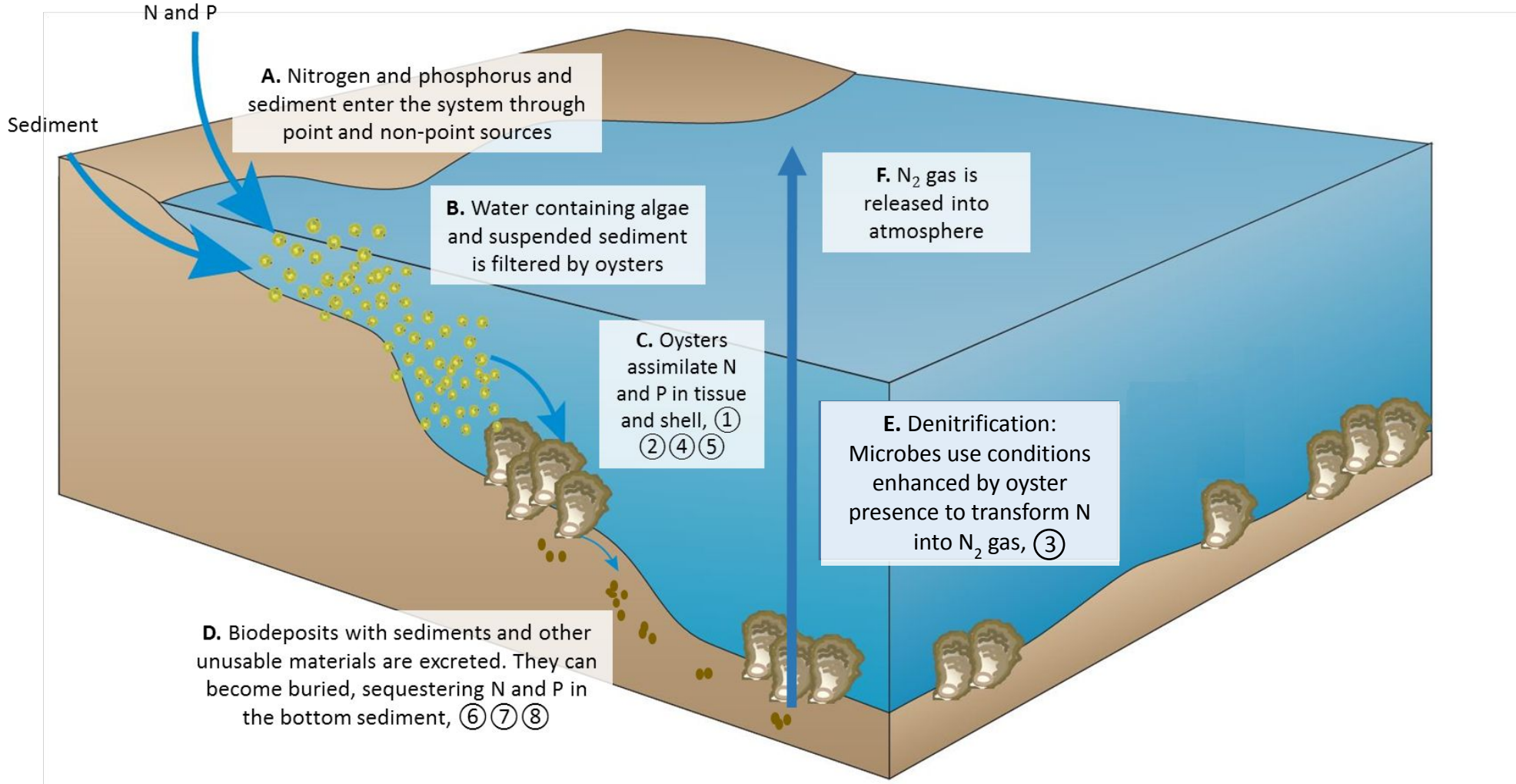
Jeff Cornwell (Chair)	UMD Center for Environmental Science
Suzanne Bricker	NOAA, National Centers for Coastal Ocean Science
Lisa Kellogg	Virginia Institute of Marine Science
Andy Lacatell	The Nature Conservancy
Mark Luckenbach	Virginia Institute of Marine Science
Frank Marenghi	Maryland Department of Natural Resources
Chris Moore	Chesapeake Bay Foundation
Matt Parker	Maryland Sea Grant (UMD)
Ken Paynter	UMD Marine, Estuarine, Environmental Sciences
Julie Rose	NOAA Northeast Fisheries Science Center
Larry Sanford	UMD Center for Environmental Science
Bill Wolinski	Talbot County Department of Public Works

Advisors, Coordinators, & Support Staff

Lew Linker	US EPA Chesapeake Bay Program Office
Jeff Sweeney/ Jeremy Hanson	US EPA Chesapeake Bay Program Office
Ralph Spagnolo	US EPA Region III
Lucinda Power	US EPA Chesapeake Bay Program Office
Rich Batiuk	US EPA Chesapeake Bay Program Office
Julie Reichert-Nguyen	Oyster Recovery Partnership
Ward Slacum	Oyster Recovery Partnership
Paige Hobaugh	Chesapeake Bay Program

Oysters as a BMP

Oysters can reduce nutrients and suspended sediment by filtering particles from water column



Oyster BMP Panel Charge

Charge 1. Identify and define oyster practices for BMP consideration.

Charge 2. Develop decision framework for incremental approval of oyster BMPs

Charge 3. Develop recommendations on N, P, and SS reduction effectiveness of oyster practices based on existing science

Oyster BMP 1st Report: Charge 1

The Panel identified 96 oyster practice-protocol combinations for BMP consideration

12 Oyster Practices:

- Private oyster aquaculture (5)
- Licensed oyster harvest (4)
- Oyster reef restoration (3)

8 Oyster Protocols:

- Assimilation in tissue and/or shell (4)
- Enhanced denitrification (1)
- Nutrient and sediment burial (3)

Oyster BMP 1st Report: Charge 2

Decision framework for incremental approval of oyster BMPs

Step 1. Determine oyster practices and protocols for evaluation.

Does an enhancement activity increase oyster production?

Step 2. Determine the reduction effectiveness estimate based on current scientific understanding.

- Number/rate of reduction
- Equation and method to calculate the estimate

Do sufficient data exist?

Step 3. Provide verification guidelines.

Does a practical method exist, or created, to track reduction?

Step 4. Identify any unintended consequences and determine if they can be addressed.

Are there positive or negative impacts on the environment?

Oyster BMP 1st Report: Oyster Aquaculture BMPs

- Reviewed 10 practice-protocol combinations for ***private oyster aquaculture practices***
- Provided recommendations for 6 combinations

3 Practices	**Practice A & B:** Off-bottom and on-bottom private oyster aquaculture using hatchery produced oysters
	Practice D: On-bottom private oyster aquaculture using substrate addition
2 Protocols	**Protocol 1.** Nitrogen assimilation in oyster tissue
	Protocol 4. Phosphorous assimilation in oyster tissue

Oyster BMP 2nd Report

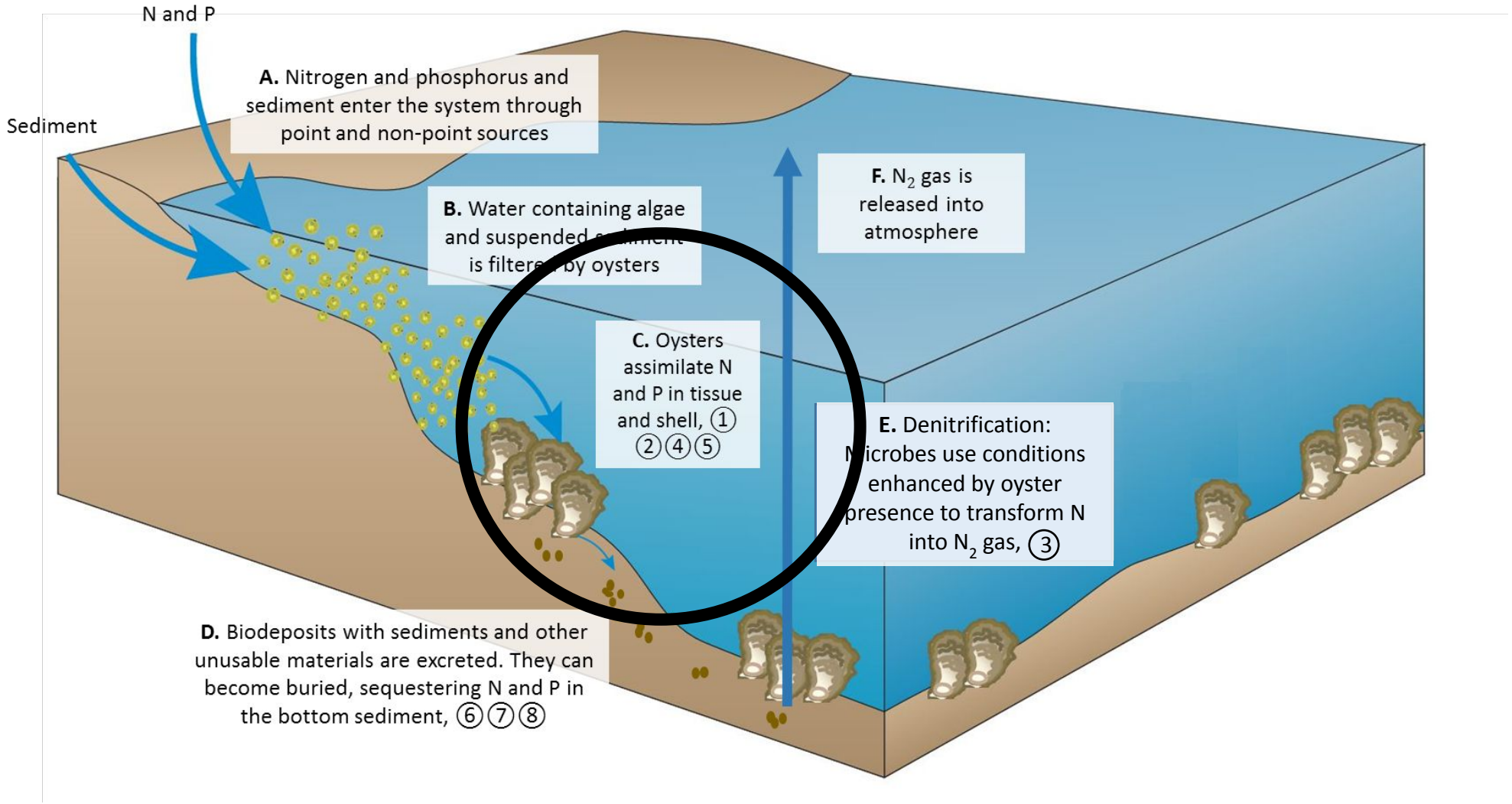
- Reviewed 45 practice-protocol combinations for ***licensed oyster harvest*** and ***oyster reef restoration practices***
- Provide recommendations for 12 combinations

3 Practices	**Practice F:** Licensed oyster harvest using hatchery produced oysters
	Practice J & K: Oyster reef restoration using hatchery produced oysters & substrate addition.
5 Protocols	**Protocol 1 & 2.** Nitrogen assimilation in oyster tissue & shell
	Protocol 4 & 5. Phosphorous assimilation in oyster tissue & shell
	Protocol 3. Enhanced denitrification associated with oysters

Oyster BMP 2nd Report

- Harvest-Assimilation BMPs
- Restoration-Assimilation BMPs
- Restoration-Denitrification BMPs

Harvest-Assimilation



Harvest-Assimilation: Practices & Protocols

1 Practices	**Practice F:** Licensed oyster harvest of hatchery-produced oysters
2 Protocols	**Protocol 1**. Nitrogen assimilation in oyster tissue **Protocol 4.** Phosphorous assimilation in oyster tissue
Implementation	• BMP site is open to harvest • Oyster tissue only • Panel recommendations impose limitations to avoid overcrediting

Harvest-Assimilation: Recommendations

To ensure that harvested oysters are from the enhancement activity, apply:

- ***Default tissue nutrient content*** – based on diploid shell height-biomass regression (1st report)
- ***Default maximum harvest allowance*** – based on # hatchery produced oysters planted and survival rate (15%)
- ***Crediting time lag*** – account for time to grow to harvest size (2 years)
- ***Maximum crediting timeframe*** – credit can be applied up to 5 years after enhancement

Using recommended default estimates, up to 15% of planted oysters can be eligible for credit 2-5 years after enhancement

Harvest-Assimilation: Determination Steps

Determination Steps:

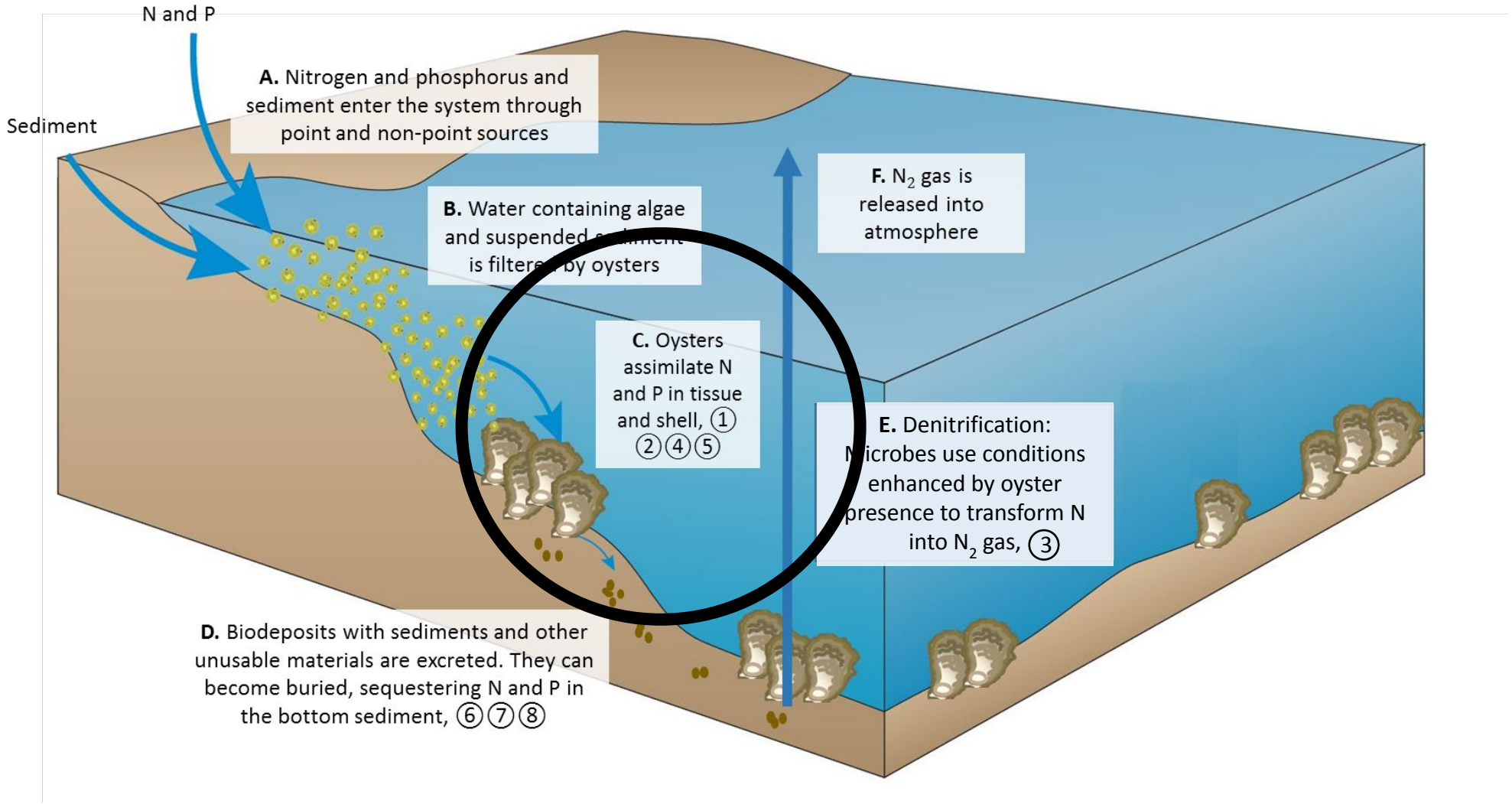
1. Determine the maximum harvest allowance (15%)
2. Determine the harvest crediting timeframe (2-5 years)
3. Determine total amount of N & P harvested
    - Verify the size and # oysters harvested

BMP Name	Oyster size class (in)	Nitrogen (lbs./million oysters)	Phosphorus (lbs./million oysters)
Diploid Licensed Oyster Harvest, Hatchery Produced 3.0 Inches	3.00-3.49*	198	22
Diploid Licensed Oyster Harvest, Hatchery Produced 4.0 Inches	3.50-4.49	331	44
Diploid Licensed Oyster Harvest, Hatchery Produced 5.0 Inches	4.50-5.49	485	44
Diploid Licensed Oyster Harvest, Hatchery Produced >5.0 Inches	≥ 5.50**	683	66

* Adjusted from 2.5-3.49. See text for details.

** Based on midpoint of 6.0 inches

Restoration-Assimilation



Restoration-Assimilation: Practices & Protocols

2 Practices	**Practice J:** Restoration using hatchery-produced oysters **Practice K:** Restoration using substrate addition
4 Protocols	**Protocol 1 & 2.** Nitrogen assimilation in oyster tissue and shell **Protocol 4 & 5.** Phosphorous assimilation in oyster tissue and shell
Implementation	• BMP site is protected from harvest • Oyster tissue and shell are eligible • Default approach for enhancement with small substrate only • Only appreciated biomass can be credited

Restoration BMPs: Small vs. Large Substrates

Small substrates

- Suitable substrate characterized by
  - ≥ 90% of material by volume ≤12 inches in diameter
  - A non-uniform or irregular structure

- Calculate oyster biomass per unit area
- Extrapolate to BMP site area

Large substrates

- Suitable substrate characterized by
  - < 90% of material by volume ≤12 inches in diameter
  - A uniform, regular structure

- Calculate oyster biomass per structure
- Extrapolate to # structures at BMP site

Default approaches are only recommended for reefs restored using *small substrate*

Restoration-Assimilation: Recommendations

Panel conducted data review to:

- Generate default oyster shell height-biomass regressions
- Identify the N & P content (%) in oyster tissue and shell biomass

	50th Quantile Regression Equation
Tissue	$y = 0.00037x^{1.83359}$
Shell	$y = 0.00147x^{2.3964}$

	N	P
Tissue	8.2%	0.9%
Shell	0.2%	0.04%

Credit can only be given for an increase in biomass that has not been credited previously

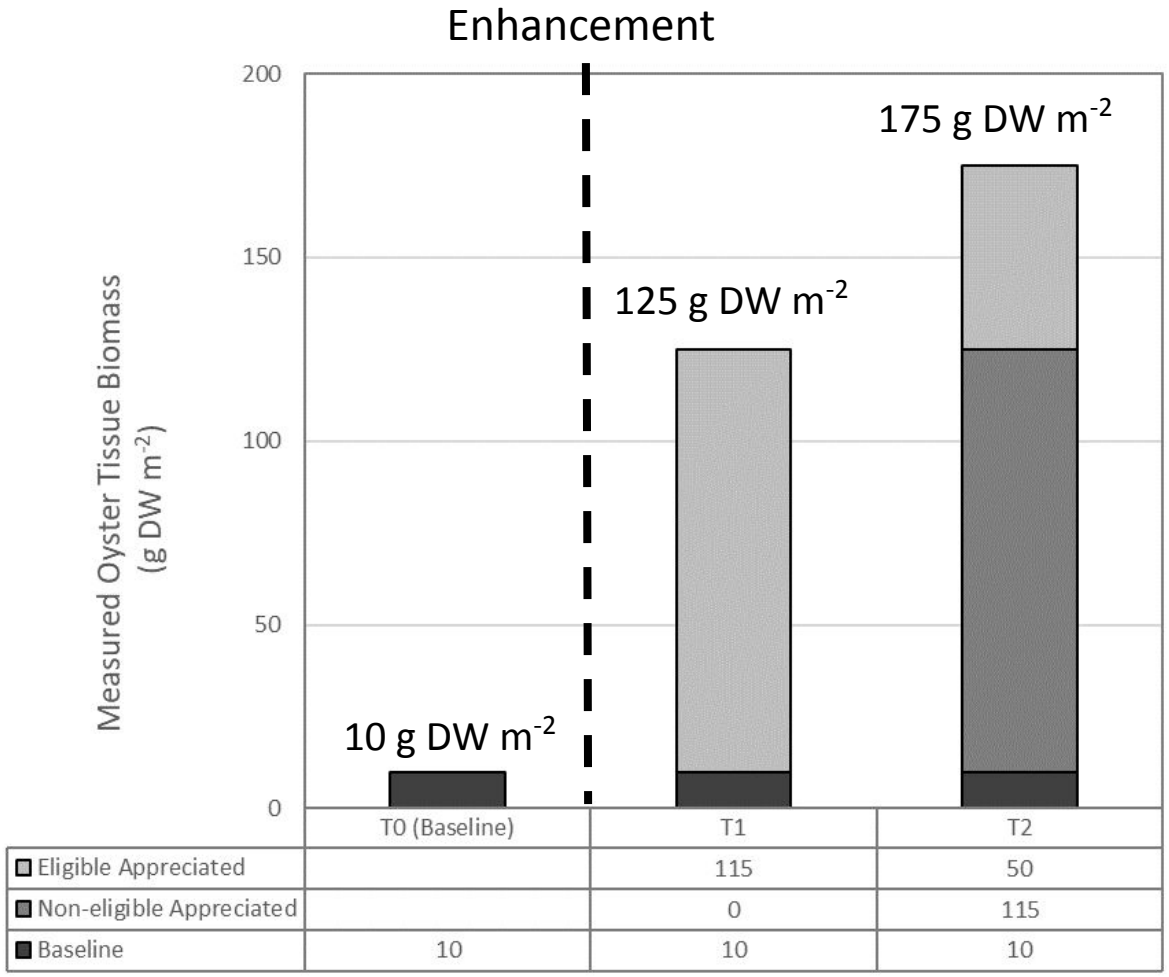
Restoration-Assimilation: Determination Steps

Determination Steps:

1. Measure baseline and post-restoration oyster biomass
2. Determine appreciated biomass
3. Estimate N & P assimilation
3. Extrapolate to BMP site area

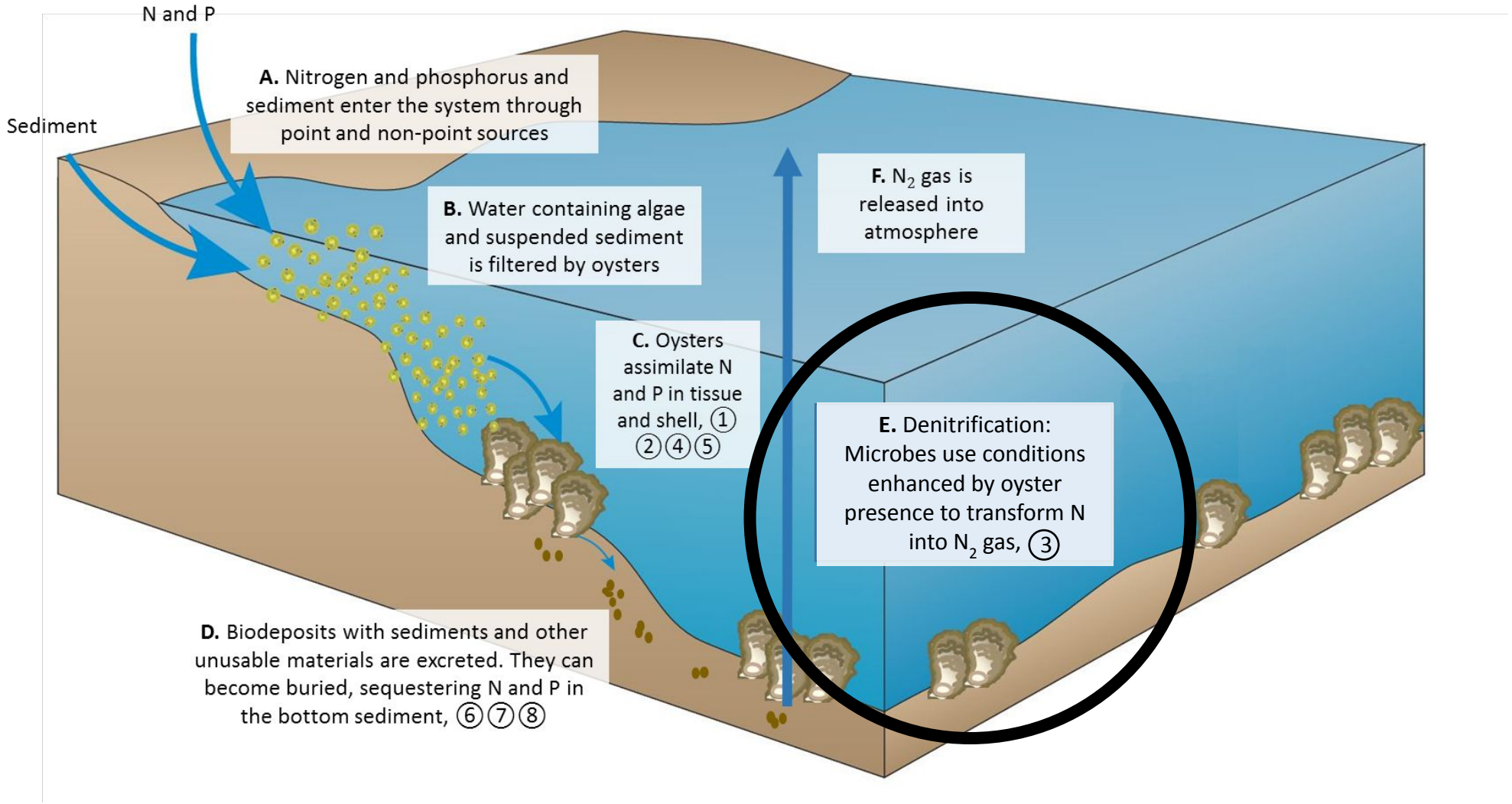
Credit timeframe:

- Within 12 months of post-restoration monitoring



	T0 (Baseline)	T1	T2
Eligible Appreciated		115	50
Non-eligible Appreciated		0	115
Baseline	10	10	10

Restoration-Denitrification



Restoration-Denitrification: Practices & Protocols

2 Practices	**Practice J:** Restoration using hatchery-produced oysters **Practice K:** Restoration using substrate addition
1 Protocol	**Protocol 3.** Enhanced denitrification associated with oysters
Implementation	• BMP site is protected from harvest • Oyster tissue only • Default approach for subtidal reefs restored with small substrate

Restoration-Denitrification: Recommendations

Panel conducted meta-analysis to:

- Estimate annual DNF rates
- Quantify relationship between oyster tissue biomass and DNF rates

Constructed lookup table to estimate enhanced nitrogen removal using:

- Baseline oyster biomass
- Post-restoration oyster biomass

Enhanced Nitrogen Removal (lbs acre^{-1} yr^{-1})		Post-restoration Oyster Biomass Range (g DW m^{-2})												
		15 - 24.9	25 - 34.9	35 - 44.9	45 - 54.9	55 - 64.9	65 - 74.9	75 - 84.9	85 - 94.9	95 - 104.9	105 - 114.9	115 - 124.9	125 - 134.9	135 - 144.9
Baseline Oyster Biomass Range (g DW m^{-2})	0 - 14.9	29	51	74	97	120	143	165	169	172	176	179	183	186
	15 - 24.9		23	46	68	91	114	137	140	144	147	151	154	158
	25 - 34.9			23	46	68	91	114	118	121	124	128	131	135
	35 - 44.9				23	46	68	91	95	98	102	105	109	112
	45 - 54.9					23	46	68	72	75	79	82	86	89
	55 - 64.9						23	46	49	53	56	59	63	66
	65 - 74.9							23	26	30	33	37	40	44
	75 - 84.9								3	7	10	14	17	21
	85 - 94.9									3	7	10	14	17
	95 - 104.9										3	7	10	14
	105 - 114.9											3	7	10
	115 - 124.9												3	7
	125 - 134.9													3

Lookup table for default approach (subtidal, small substrate)

Restoration-Denitrification: Determination Steps

Determination Steps:

1. Measure baseline and post-restoration oyster tissue biomass
2. Estimate enhanced nitrogen removal using lookup table
3. Extrapolate to BMP site area

Credit timeframe:

- Annually for up to 3 years

Enhanced Nitrogen Removal (lbs acre^{-1} yr^{-1})		Post-restoration Oyster Biomass Range (g DW m^{-2})												
		15 - 24.9	25 - 34.9	35 - 44.9	45 - 54.9	55 - 64.9	65 - 74.9	75 - 84.9	85 - 94.9	95 - 104.9	105 - 114.9	115 - 124.9	125 - 134.9	135 - 144.9
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	45 - 54.9					23	46	68	72	75	79	82	86	89
	55 - 64.9						23	46	49	53	56	59	63	66
	65 - 74.9							23	26	30	33	37	40	44
	75 - 84.9								3	7	10	14	17	21
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Lookup table for default approach (subtidal, small substrate)

Oyster BMP 2nd Report Summary

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- Provide recommendations for 12 combinations

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Oyster BMP 2nd Report Summary

BMP	Verification Step	Credit Timeframe
Harvest-Assimilation	Quantify size and # of oysters harvested	2-5 years after enhancement
Restoration-Assimilation	Measure baseline and post-restoration oyster biomass	Within 12 months of biomass assessment Lifetime of BMP
Restoration-Denitrification	Measure baseline and post-restoration oyster biomass	Annually for up to 3 years after biomass assessment Lifetime of BMP

Oyster BMP 2nd Report Summary

The Panel concluded:

- Oyster biomass required to estimate reduction effectiveness
- Verification is required to determine whether enhancement improves oyster production
- Crediting approaches are intentionally conservative to minimize overcrediting
- Several research gaps and future work remain

Upcoming BMP dates

- Submitted and available for review in August 2022
- Webinars will be hosted in late August-early September 2022