Sanctuary Oyster Reefs

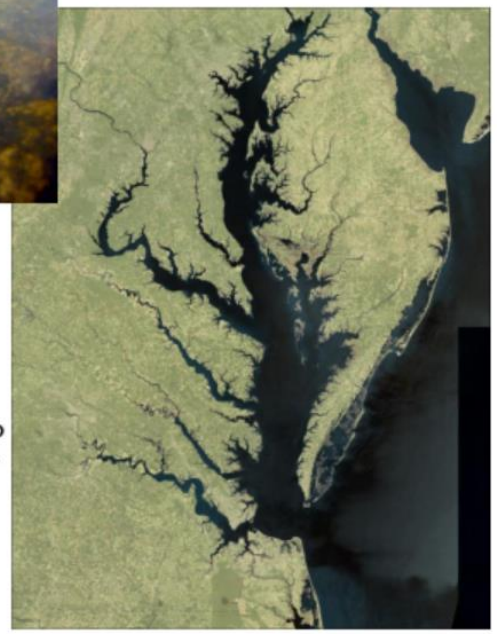
Presentation by the
City of Virginia Beach
November 2, 2015

Oysters

- Filter feeders that improve water quality
- Single adult oyster can filter 50 gallons of water in 24 hours.
- Consume algae and phytoplankton
- Remove nitrogen and sediment
- Prone to Diseases caused by MSX and Dermo

Chesapeake Bay Oyster Recovery: Native Oyster Restoration Master Plan

Maryland and Virginia



SEPTEMBER 2012

Prepared by
U.S. Army Corps of Engineers
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ASSESSMENT OF OYSTER REEFS IN LYNNHAVEN RIVER AS A CHESAPEAKE BAY TMDL BEST MANAGEMENT PRACTICE

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Final Report to the

U. S. Army Corps of Engineers, Norfolk District
and
The City of Virginia Beach

Special Report No. 429
In Applied Marine Science and Ocean Engineering

Virginia Institute of Marine Science
Department of Physical Sciences
Gloucester Point, Virginia 23062

December 2011

Oysters

- **The VIMS report showed that oysters play a very important role in removing excess nitrogen through consumption of phytoplankton.**

- Nitrogen removal rate through nitrification/denitrification at the oyster reef sites range from 15 – 20 pounds/acre/month
- For bare sediment, nitrogen removal by nitrification/denitrification was 1 pound/acre/month

- Total nitrogen sequestered by oyster and other organisms on the reef ranged from 495 – 656 pounds/acre
- For bare sediment, total nitrogen sequestered by various mechanisms was 32 pounds/acre

Table IV.1. Summary estimates of nitrogen fluxes and sequestration by site. See text for discussion of methods used to calculate monthly rates and constraints on their proper use.

	Site							
	HM0	**HMLsed**	**HML**	**HMM**	**HMH**	**1F2F**	**LCW**	**LCE**
Nitrogen recycling rates $NH_4^+ + NO_{2+3}$ flux								
µmoles m^{-2} hr^{-1}	-131.81	141.71	774.99	1482.46	1620.06	539.07	139.07	1148.33
lbs $acre^{-1}$ $month^{-1}$	-11.83	12.72	69.55	133.04	145.39	48.38	12.48	103.05
Nitrogen removal via denitrification								
µmoles m^{-2} hr^{-1}	11.47	25.28	168.59	123.44	225.15	108.46	153.79	319.59
lbs $acre^{-1}$ $month^{-1}$	1.03	2.27	15.13	11.08	20.21	9.73	13.80	28.68
Nitrogen removal via sequestration								
g m^{-2}	3.66	12.04	73.70	71.46	55.66	30.60	59.19	7.00
lbs $acre^{-1}$	32.6	107.25	656.48	635.53	495.79	272.57	527.23	62.45

Nitrogen removal via nitrification/denitrification at oyster reef sites ranged from 15 to 28 pounds/acre/month compared to bare sediment sites of 1.03 pounds/acre/month for the months sampled.

Source: Assessment of Oyster Reefs in Lynnhaven River as a Chesapeake Bay TMDL Best Management Practice

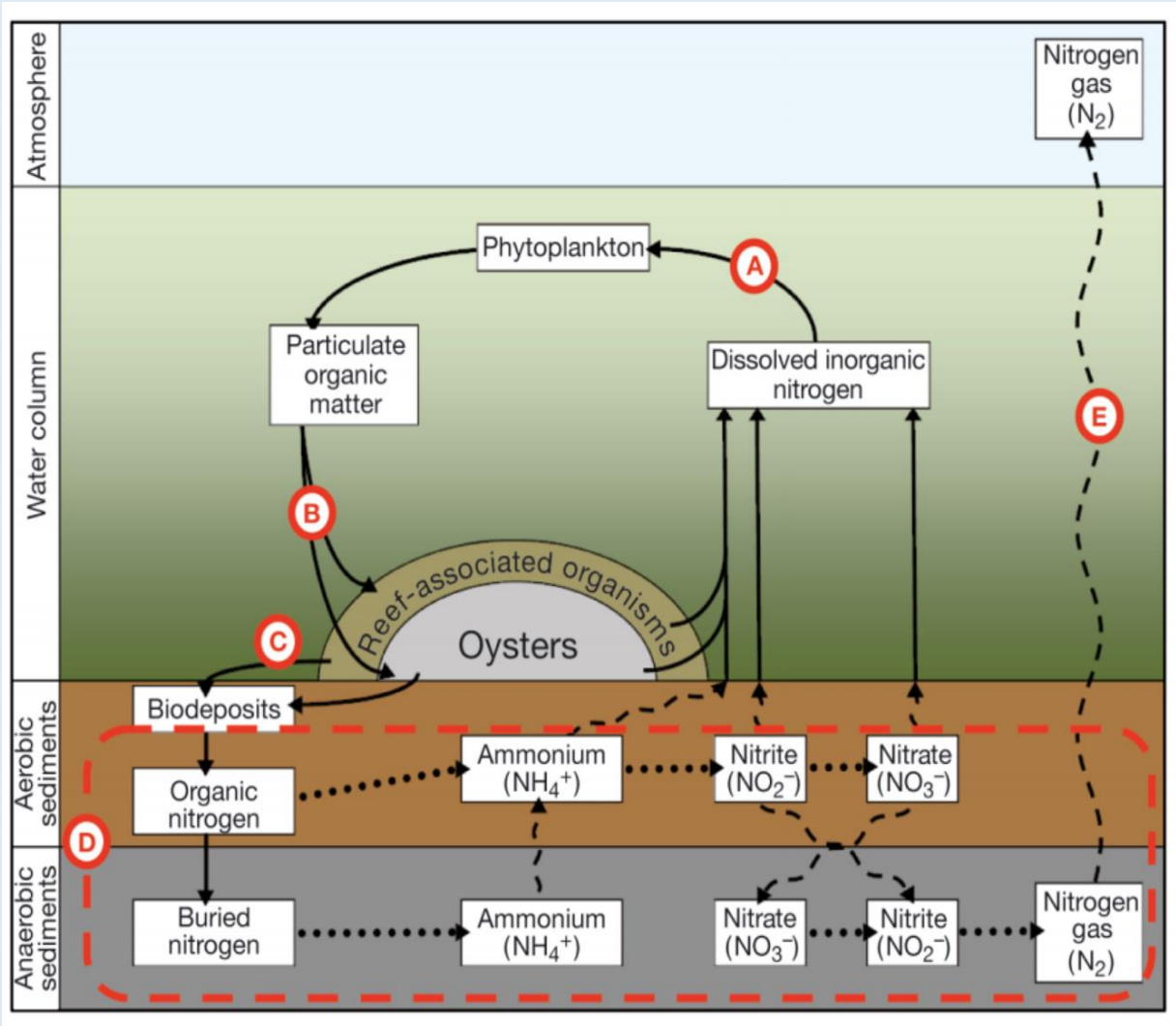
Oysters

Fig. 1. Primary nitrogen pathways associated with oyster reefs at intermediate depths in Chesapeake Bay, USA: phytoplankton use dissolved inorganic nitrogen for their growth (A), oysters and other reef-associated organisms filter phytoplankton and other particulate organic matter from the water column (B), some of the associated nitrogen is incorporated into organisms and some is deposited on the surface of the sediments (C), and, given the right conditions, a portion of the nitrogen in these bio-deposits is transformed into nitrogen gas (D) which diffuses out of the sediments back to the atmosphere (E) where it is no longer available to phytoplankton for growth (diagram adapted from Newell et al. 2005)

Legend

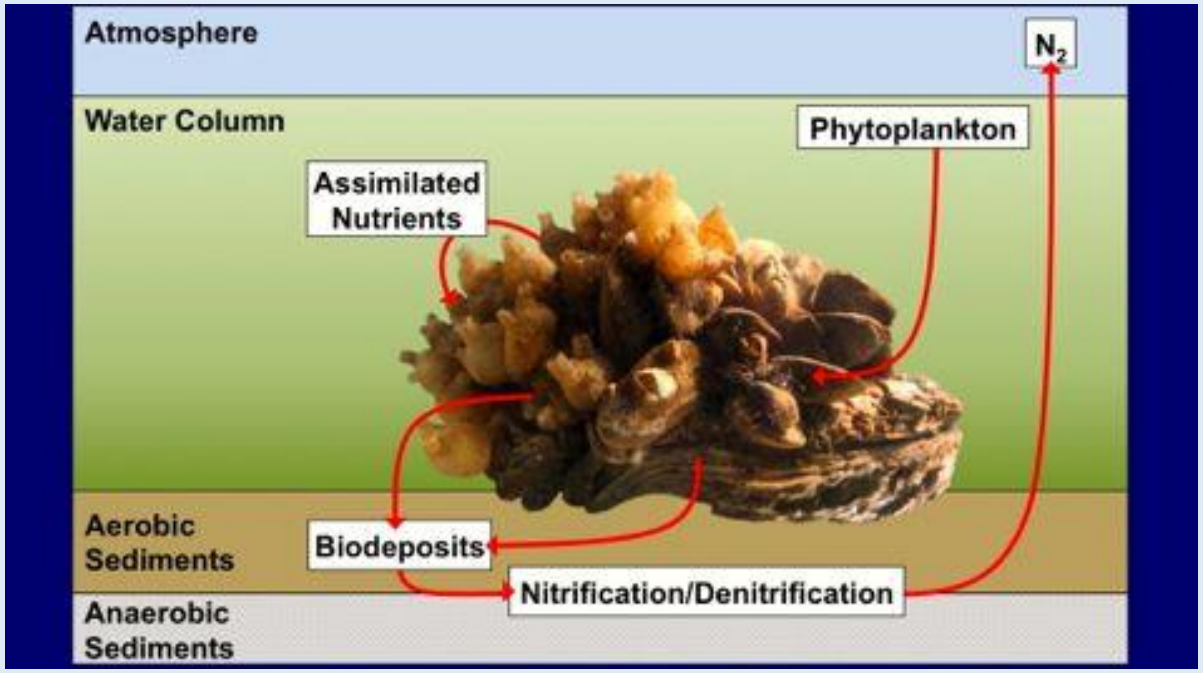
---------- Transfer of Materials
- - - - - - Diffusion of materials
●●●●● Microbial Mediated Reactions

Source: Assessment of Oyster Reefs in Lynnhaven River as a Chesapeake Bay TMDL Best Management Practice



Sanctuary Reefs

- Closed to harvesting
- Allow maximum reproduction
- Expected to increase abundance of adult oysters

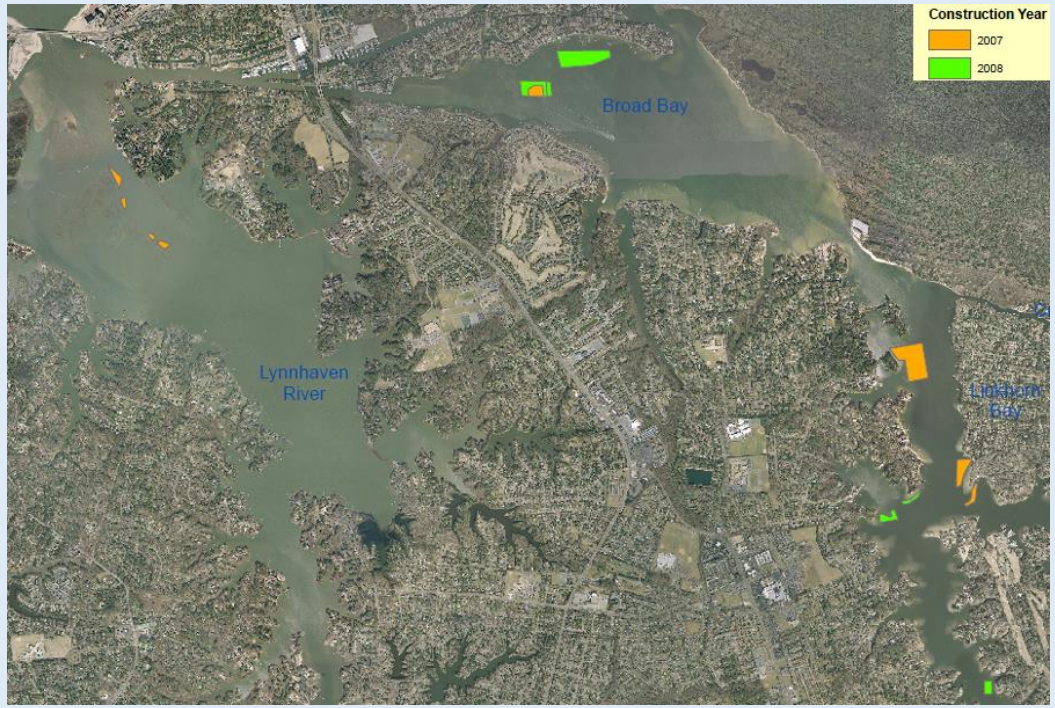


- Expect larvae to settle within and without the sanctuary thereby expanding the reef
- Accelerates greater disease resistance by selective breeding – the oysters that survive and reproduce

Sanctuary Reefs as BMPs

- Traditional BMPs do not remove 100% of the nutrients

- With nitrogen removal efficiency at 20% for most BMPs, allowing 80% of nitrogen to pass downstream



- Sanctuary Reefs would help remove some of this passed-through nitrogen by polishing the water

Sanctuary Reefs as BMPs

- This is a proposed method for nitrogen polishing from the waters
- Assist with compliance with the Chesapeake Bay TMDL
- Based solely on the ability of oyster reefs to remove nitrogen from the water column by the process of nitrification/denitrifcation
- Not intended to replace traditional stormwater BMPs but act as a creditable polishing BMP
- Phosphorus removal is not included in the request at hand

Sanctuary Reefs as BMPs

- Reef would be created by placing oyster shells on substrate
- Spat-on-shell added to maintain healthy reef
- Monitored for overall health and nitrogen removal efficiency

Sanctuary Reefs as BMPs

- Measure nitrogen in relation to oyster density and biomass
- Measure nitrification/denitrification rates at selected reef sites for 15-18 months
- Submit results to the Commonwealth of Virginia and EPA, Region 3
- Establish a permanent (non-provisional) nitrogen removal rate

Sanctuary Reefs as BMPs

Other Issues

- Provide ancillary benefit to harvestable reefs by providing disease resistant wild spat to nearby sink reefs
  - Sink reefs are produced from source reefs due to fluctuations in tides and currents during spawning periods
  - Sink reefs can provide more nitrogen removal benefits on these other reefs
- Provide ancillary benefit by serving as fish and other aquatic life safe zones

Sanctuary Reefs as BMPs

- POTENTIAL ISSUES IMPEDING SANCTUARY REEF USE AND PROPOSED SOLUTIONS
  - Oyster mortality – monitor and add more spat-on-shell
    - Spat-on-shell – commercially available and potentially by future City of Virginia Beach facility
  - Cownose Ray and Blue Crab predation – monitor and add a bounty on ray tails; monitor and selective harvesting of Blue Crabs

  - Poaching – monitor and enforce no harvest zones by City marine police

Sanctuary Reefs as BMPs

- Planting oyster shell for restoration of the Lynnhaven River. Photograph provided by USACE-Norfolk.

Sanctuary Reefs as BMPs

- Lynnhaven River has 63 acres of sanctuary reefs by the end of 2014.
- Sanctuary Reefs were constructed by USACE, City of Virginia Beach, Chesapeake Bay Foundation and Lynnhaven NOW.
- All of these reefs exceeded the Goal Implementation Team thresholds for adult oysters density and biomass.

Table ES-1. Tier 1 Tributaries and Restoration Targets

Tier 1 Tributaries/Areas	*Restoration Target (Acres)*
Maryland	
Severn River	190 – 290
South River	90 – 200
Lower Chester River	500–1,100
Lower Eastern Bay	700 – 1,400
Upper Eastern Bay	800 – 1,600
Lower Choptank River	1,400 – 2,800
Upper Choptank River	400 – 800
Harris Creek	300 – 600
Little Choptank	400 – 700
Broad Creek	200 – 400
St. Mary's River	200 – 400
Lower Tangier Sound	800 – 1,700
Upper Tangier Sound	900 – 1,800
Manokin River	400 – 800
Virginia	
Great Wicomico River	100 – 400
Lower Rappahannock River	1,300 – 2,600
Piankatank River	700 – 1,300
Mobjack Bay	800 – 1,700
Lower York River	1,100 – 2,100
Pocomoke/Tangier Sound	3,000 – 5,900
Lower James River	900 – 1,800
Upper James River	2,000 – 3,900
Elizabeth River	200 – 500
Lynnhaven River	40 – 150

Source: Chesapeake Bay Oyster Recovery: Native Oyster Restoration Master Plan, Lynnhaven River NOW

Existing Healthy Reefs in Virginia Beach

Alanton Reef

Humes Marsh Reef

Sanctuary Reefs as BMPs – Cost/Pound/Year

CONSTRUCTION COST FOR REMOVAL OF TOTAL NITROGEN (TN)	
BOAT PUMP OUTS	$80
STREET SWEEPING	$2,500
BIORETENTION BASIN	$2,500
SANCTUARY OYSTER REEFS	$1,350
WET PONDS	$2,000

Source: Potential Chesapeake Bay Water Quality Treatment Activities – City of Virginia Beach, Public Works, revised 9/22/2015

QUESTIONS?

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