Memorandum

To: James Davis-Martin (Virginia Department of Conservation & Recreation)
From: Steve McLaughlin (City of Virginia Beach)
CC: John Paine (URS)
Date: 24 July 2013

Subject: Boat Pump Outs in the Lynnhaven River No Discharge Zone as a BMP

Purpose

Chesapeake Bay TMDL requirements have municipalities in Virginia viewing the role of traditional stormwater BMPs in a new light. Amended local ordinances requiring stormwater BMPs to treat runoff to higher and higher standards for both new development and redevelopment may help localities meet their Watershed Implementation Plans (WIPs); however, the construction of traditional BMPs alone, such as wet ponds, will not meet the reduction requirements set forth by the Chesapeake Bay TMDL. Many localities within the Chesapeake Bay watershed contain stormwater systems that are currently not treated by any type of BMP. In older built-out urban areas, public land may not be available for the construction of BMPs, or available public land is located in an area where treatment of stormwater is not possible, such as the high points of a watershed, far from any stormwater outfalls. Some BMPs, such as manufactured filtering devices, or bio-retention areas are designed to treat runoff from relatively small areas of a few acres at most. Heavily developed localities, trying to reduce their nutrient runoff, often need to treat stormwater from large areas of a watershed to make a significant impact to their pollution reduction goal, especially when using BMPs with limited efficiencies, such as wet ponds. In order meet their TMDL reduction goals some localities are considering innovative BMPs to help achieve TMDL compliance in a cost-effective manner.

The City of Virginia Beach would like to propose "Boat Pump outs within the Lynnhaven River No-Discharge Zone" be included as a nutrient reducing water quality BMP and an acceptable method for nitrogen and phosphorus removal from the Lynnhaven River watershed, in order to comply with the Chesapeake Bay TMDL. The Lynnhaven was first designated as a No Discharge Zone (NDZ) in 2007. Since then, the City of Virginia Beach, Hampton Roads Sanitation District (HRSD), and Virginia Department of Health (VDH) have provided boaters with free holding tank pump outs on weekends between Memorial Day and Labor Day. In addition, the City recently constructed a new 24-hour self-service pump out facility at the City Marina in Long Creek. With more than 90% of the City's approximately 13,000 documented or registered boats in the City of Virginia Beach located in the Lynnhaven watershed, thousands of gallons of marine sewage have been pumped from vessel holding tanks, rather than being discharged into the Lynnhaven River by vessels with Type I or Type II marine sanitation devices (MSDs). Since MSDs are not designed to reduce nutrients, the nitrogen levels in boat waste are more than 40 times higher than

domestic raw-water sewage to treatment plants. By taking steps to have the Lynnhaven River declared a NDZ by the EPA, providing for free holding tank pump outs during the peak of boating season, and updating self-service pump out facilities for use by boat owners the City has reduced the annual discharge of nitrogen and phosphorus into the Lynnhaven River.

Background

The Lynnhaven River watershed encompasses approximately 64 square miles of Virginia Beach's northeast corner and discharges directly into the Chesapeake Bay through Lynnhaven Inlet. Within the Lynnhaven River watershed are the east and west branches of the Lynnhaven River and the adjacent water bodies of Broad Bay and Linkhorn Bay. More than 4,400 private homes are located on the Lynnhaven watershed's 150 miles of shoreline, as well as numerous restaurants, and marinas. During the summer months, the Lynnhaven River area is an extremely popular spot for recreation and boating.

Poor water quality in the eastern and western branches of the Lynnhaven, as well as Broad and Linkhorn Bays, has been an issue for many years due to high levels of bacteria. A 1975 report by the Virginia State Water Control Board (SWCB) stated that high levels of bacteria were the result of failing residential septic systems within the watershed and the high level of boating activity. Since the 1970s, the City has spent considerable time, effort, and funds to reduce bacteria levels in stormwater from land based sources such as septic systems. Presently, almost all waterfront lots in the Lynnhaven watershed are connected to sanitary sewer systems. However, both branches of the Lynnhaven, as well as Broad Bay and Linkhorn Bay, have impairments according to the Virginia Department of Environmental Quality (DEQ). Between 2002 and 2004, 45 of 53 stations sampled by the VDH Division of Shellfish Sanitation in the Lynnhaven failed to meet the National Shellfish Sanitation Standard for fecal coliform bacteria, and in 2004 EPA approved a TMDL for the shellfish harvest impairment. In November of 2006, the City of Virginia Beach and DEQ submitted the application to have the Lynnhaven River watershed designated as a Federal NDZ. In the spring of 2007, the designation was approved by the EPA. Part of the NDZ application process was to show "that adequate facilities for the safe and sanitary removal and treatment of sewage from vessels in the Lynnhaven River Watershed are reasonably available." Calculations to estimate the number of vessel pump out facilities and dump stations required in the Lynnhaven watershed for a NDZ designation followed the guidelines found in EPA's "Protecting Coastal Waters from Vessel and Marina Discharges; A guide for State and Local Officials. Volume I. Establishing No Discharge Areas under section 312 of the Clean Water Act" (August, 1994). Those calculations showed that based on the number of boats within the Lynnhaven watershed, 2.1 pump out facilities, and 4.4 dump stations were required to service vessels adequately during peak periods (i.e. holiday weekends during summer months). At the time of the application, there were 6 pump out facilities and 6 dump stations within the Lynnhaven watershed; enough to ensure the additional removal and treatment of marine waste from vessels due to the NDZ designation.

In 2007, shortly after the NDZ designation went into effect, the City together with HRSD assigned a City-funded boat pump out team to the Lynnhaven River to provide free vessel pump outs as part of the City's "Boater Education and Pump Out Program." Boaters were offered one free pump out per year. Pump outs were provided on weekends; Friday-Sunday, between Memorial Day and Labor Day. In 2007, more than 1,000 gallons of marine sewage was collected and transported to an HRSD wastewater treatment plant. The City and HRSD have continued the program, and its pump out team has collected over 8,800 gallons of wastewater from boats through 2012. A new self-service, around the clock, free, deep draft pump out facility was constructed at the City Marina on Long Creek to replace the existing facility. As with other pump stations located at marina facilities in the Lynnhaven watershed, the number of gallons of wastewater pumped from vessels annually is not known. Since the NDZ designation in 2007, there have been improvements in the bacteria levels within the Lynnhaven watershed. In its "2012 State of the River Report" the citizens group Lynnhaven River NOW reported that 42% of the river is currently open to shellfish harvest, and that 90% of the river meets the fishable/swimmable bacteria standard. The NDZ designation of the Lynnhaven watershed has not only prevented bacteria from entering the Lynnhaven and its adjacent waters, but also nutrients such as nitrogen and phosphorus that are found in very high levels in vessel sewage.

Lynnhaven Study

During the first year of the City's boat pump out program with HRSD, 1,063 gallons of wastewater was pumped from holding tanks aboard 54 vessels in the Lynnhaven watershed between May 26th and September 3rd, 2007. The average volume of wastewater removed per vessel was approximately 20 gallons. To help understand the effects that vessel discharges were having in the Lynnhaven watershed before the NDZ designation, 12 samples were taken from vessel wastewater between June 10th and August 19th, 2007. The samples were sent to an HRSD lab and analyzed for levels of fecal coliform, biochemical oxygen demand (BOD), chemical oxygen demand (COD), total nitrogen (TN), and total phosphorus (TP). Details of the study and findings are found in "Lynnhaven River Boat Wastewater Sampling Program" (February 2008) prepared for the City of Virginia Beach by KCI Lewis White & Associates.

The analyses showed that in addition to very high levels of fecal coliform, BOD and COD, the pump out samples had an average nitrogen and phosphorus concentrations approximately 44 times higher and 20 times higher respectively than domestic raw sewage entering the Chesapeake-Elizabeth waste water treatment plant. The average pollutant concentrations from the sampled boat wastewater are compared with concentrations from raw and treated sewage from the Chesapeake-Elizabeth wastewater treatment plant in Table 1 below, taken from the 2008 sampling program report.

Table 1. Boat Waste Pollutant Concentrations Compared to Raw and Treated Sewage at the Chesapeake Elizabeth Waste Water Treatment Plant

Source	Pollutant Concentration				
	BOD (mg/l)	COD (mg/l)	Total Nitrogen (mg/l)	Total Phosphorus (mg/l)	Fecal Coliform #/100 ml
Sampled Boat Wastewater	3,172	11,136	1,662	117	7,500,000
Raw Sewage Entering Chesapeake-Elizabeth Treatment Plant	242	463	38	5.7	ND
Treated Effluent Leaving Chesapeake-Elizabeth Treatment Plant	1.5	ND	3.1	1.4	4
Ratio of Boat Waste to Raw Sewage	13.11	24.05	43.74	20.53	ND

ND – Data not available

Nitrogen and Phosphorus Removal through Boat Pump Outs in the Lynnhaven NDZ

The City of Virginia Beach is committed to improving water quality and meeting its Chesapeake Bay TMDL goals. The City has taken important steps to improving water quality in the Lynnhaven watershed by constructing and improving sanitary sewer systems and eliminating almost all septic tanks along the Lynnhaven watershed shoreline, partnering with the United States Army Corps of Engineers (USACE) and the Virginia Institute of Marine Science (VIMS) to study the creation of oyster reefs within the Lynnhaven, and spending millions of dollars on stormwater projects designed to improve water quality. By having the Lynnhaven watershed designated as a No Discharge Zone, partnering with groups such as HRSD to provide free boat pump outs during peak boating months, and ensuring adequate pump out facilities by constructing a new self-service pump out station, the City has eliminated a source of nitrogen and phosphorus in the watershed.

To estimate the annual amount of nitrogen and phosphorus removed through boat pump outs and not discharged into the Lynnhaven watershed due to the NDZ designation, the number of boats requiring pump outs in the Lynnhaven watershed must be estimated. The number of pleasure boats (Type 3 boats) registered in the City of Virginia Beach in 2013 is 13,164. This number was used to calculate boat tax revenue for the City's fiscal year 2013-2014 budget. Boat numbers were not broken down by watershed. Vessel information from the "Lynnhaven River Watershed Application for Federal No Discharge Zone Designation" was used to extrapolate vessel numbers by length in the Lynnhaven watershed. Table 2 below shows the 2004 vessel

information from the NDZ application and the 2013 extrapolated vessel numbers for the Lynnhaven watershed.

Table 2. Estimated Numbers of Vessels in the Lynnhaven Watershed in 2013

Vessel Length	Total Number of Vessels (2004)[1]			Total Number of Vessels (2013)[3]	
	Va. Beach	Lynnhaven	% of all boats in Va. Beach	Va. Beach	Lynnhaven
< 16'	2,911	2,883	25%	3,333	3,301
16' – 26'	7,324	7,272	63%	8,386	8,326
27' – 40'	1,033	899	8%	1,183	1,029
> 40'	229	199	2%	262	228
Total	11497[2]	11,253	98%[2]	13,164[4]	12,884

1. Source Va. Dept. of Game and Inland Fisheries Boater Registration Database, 2004.
2. Total number of vessels does not include commercial vessels. Lynnhaven NDZ application states that the Lynnhaven has limited commercial vessels and vessel numbers are primarily recreational.
3. Total of 13,164 came from Commissioner of the Revenue in a response to City Council about FY 2013-2014 budget.
4. Does not include 506 commercial vessels registered in Va. Beach.

Annual volume of boat pump out effluent was estimated by calculating the number of vessels requiring pump outs at peak boating times (summer holiday weekends) using the Boater Sanitary Waste Reception Facility Requirements Worksheet found in section 4.1.7 of EPA's "Protecting Coastal Waters from Vessel and Marina Discharges; A Guide for State and Local Officials. Volume I. Establishing No Discharge Areas under section 312 of the Clean Water Act" (August, 1994). From the 2013 vessel numbers for the Lynnhaven estimated above and the estimate of required pump out facilities worksheet, the following parameters can be used to estimate the toal number of vessels requiring pump outs per weekend:

Number of local vessels 27-40 feet in length	= 1,029
Percent with holding tanks	= 25% for Virginia
Local vessels 27-40 with holding tanks: (1029) x (.25)	= 257
Local number of vessels over 40 feet in length	= 228
Total number of local vessels with holding tanks	= 485
Suggested default peak occupancy rate	= 40%
Number of local vessels requiring pump outs: (485) x (.4)	= 194
Number of transient vessels 27-40 feet in length	= 10
Transient vessels 27-40 with holding tanks: (10) x (.25)	= 3
Number of transient vessels* over 40 feet in length	= 0
Number of transient vessels with holding tanks	= 3
Number of transient vessels requiring pump outs	= 3
Total number vessels requiring pump outs (194) + (3)	= 197

*Note: the transient vessel information taken from the Lynnhaven NDZ application is based on information provided by operators of three public boat ramps in the Lynnhaven watershed.

In determining the number of vessels requiring pump outs, vessels less than 27 feet in length were not included. Although there are more than 8,000 vessels between 16 and 26 feet in length within the Lynnhaven watershed, boats this size generally do not have Type I or Type II MSDs due to cost. For the purposes of calculating an annual pump out volume, boats less than 27 feet long were assumed to have Type III MSDs or portable toilets that could not be discharged before the NDZ designation was enacted.

Assuming that most boating activity and therefore most pump outs take place during late spring through early fall, annual pump out volumes can be calculated for twenty-one (21) weekends from the beginning of May to the end of September. This gives a conservative estimate for pump out volumes by not considering weekdays, or the 7 other months of the year which include other popular boating times such as late fall during striped bass season, and allows for the fact that the calculated number of vessels requiring pump outs is for a peak time such as a holiday weekends.

Using the number of vessels requiring pump outs calculated above for the weekends from May to September, and an average of 20 gallons per pump out per vessel, the annual volume of pump out effluent in gallons is:

(20 gallons/vessel) x (197 vessels/ weekend) x (21 weekends/year) = 82,740 gallons/year

Using the nitrogen and phosphorus concentrations from the Lynnhaven River Boat Wastewater Sampling Program report, the annual load of nitrogen and phosphorus that can no longer be legally discharged into the Lynnhaven watershed is shown in Table 3 below.

Table 3. Estimated Annual Nitrogen and Phosphorus Amounts Pumped Out from Vessels

Nutrient	Concentration in Boat Waste from Lynnhaven Study (mg/l)	Concentration in lbs./gallon	Annual Volume of Wastewater Pumped from Vessels in the Lynnhaven Watershed	Pounds of Nutrients Removed Annually Through Boat Pump Outs
Nitrogen	1,662	.01386	82,740	1,147
Phosphorus	117	.00098	82,740	81

Based on nutrient concentrations in boat sewage sampled during the Lynnhaven Boat Waste study, and estimates of vessel numbers and annual pump out volumes in the Lynnhaven watershed, the City has eliminated approximately 1,147 pounds of nitrogen and 81 pounds of phosphorus from being discharged into the Lynnhaven River by implementing No Discharge Zone designation. By ensuring there are enough pump out facilities for boat owners, and providing free boat pump outs annually, the City has also reduced the temptation for boat

owners to discharge their MSDs into the Lynnhaven illegally due to a lack of pump out facilities or dump stations.

Based on data from the City's Lynnhaven River Boat Water Sampling Program, and estimated vessel numbers in the Lynnhaven, as explained above, the City would like to propose that the City's Boat pump out program, and designation of the Lynnhaven watershed as a No Discharge Zone be granted a removal rate of 1,147 pounds of nitrogen per year, and 81 pounds of phosphorus per year, for credit towards the Chesapeake Bay TMDL pollutant reduction goals.

The City would also like to request specifically that these proposed rates be acceptable for use in planning *and* reporting Chesapeake Bay TMDL action plan progress. In other words, the City can claim 1,147 pounds of nitrogen per year, and 81 pounds of phosphorus per year credit for Chesapeake Bay TMDL purposes.

Thank you!