An Ecological Study of Hunting Creek

2015

FINAL REPORT

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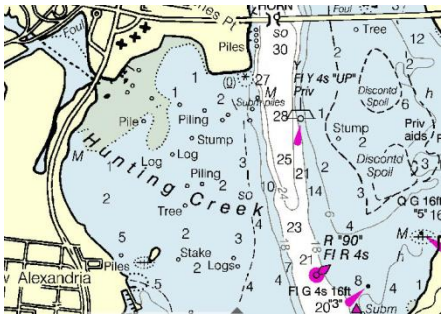
by



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Executive Summary

Hunting Creek is an embayment of the tidal Potomac River located just downstream of the City of Alexandria and the I-95/I-495 Woodrow Wilson bridge. This embayment receives treated wastewater from the Alexandria Renew Enterprises wastewater treatment plant and inflow from Cameron Run which drains most of the Cities of Alexandria and Falls Church and much of eastern Fairfax County. Hunting Creek is bordered on the north by the City of Alexandria and on the west and south by the George Washington Memorial Parkway and associated park land. Due to its tidal nature and shallowness, the embayment does not seasonally stratify vertically, and its water is flushed by rainstorms and may readily mix with the adjacent tidal Potomac River mainstem. Beginning in 2013 the Potomac Environmental Research and Education (PEREC) in collaboration with Alexandria Renew Enterprises (AlexRenew) initiated a program to monitor water quality and biological communities in the Hunting Creek area including stations in the embayment itself and the adjacent river mainstem. This document presents study findings from 2015 and compares them with 2013 and 2014 data. In addition special studies were conducted on anadromous fish usage of Hunting Creek and Cameron Run, *Escherichia coli* levels in Hunting Creek and tributaries, and micropollutant levels in sediments and waters of Hunting Creek and Cameron Run.

The Chesapeake Bay, of which the tidal Potomac River is a major subestuary, is the largest and most productive coastal system in the United States. The use of the Bay as a fisheries and recreational resource has been threatened by overenrichment with nutrients which can cause nuisance algal blooms, hypoxia in stratified areas, and declining fisheries. As a major discharger of treated wastewater into Hunting Creek, AlexRenew has been proactive in decreasing nutrient loading since the late 1970's.

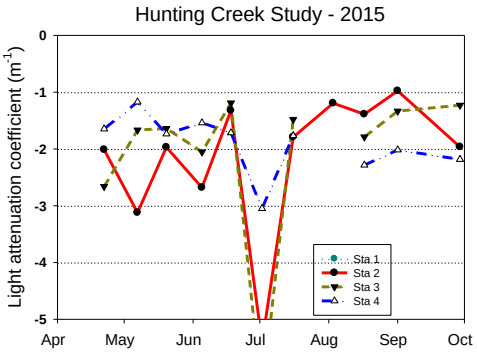
The ecological study reported here provides documentation of the current state of water quality and biological resources in Hunting Creek. The year 2015 was characterized by above normal temperatures from April through September with highest monthly average of 27.4°C in July. Precipitation was well above normal in June and early July, but well below normal in August and September. Mean monthly discharge of the mainstem Potomac at Little Falls was near normal during most of the study period, but was well above normal in June and July . Local tributary inflow into Hunting Creek from Cameron Run was also well above normal in June and July. This freshwater input surge had a major impact on numerous parameters

which will be discussed after a general review of seasonal trends.

Water temperature tracked air temperature on a seasonal basis with little difference among the four sites. Specific conductance and chloride showed a consistent gradual seasonal increase. Dissolved oxygen was generally in the 80-120 % saturation range. pH was generally in the 7-8 range at all sites except at AR2 and AR3 in late July and late August when SAV was rapidly photosynthesizing. Total alkalinity was generally 60-80 mg/L as $CaCO_3$. Water clarity levels were best tracked using light attenuation coefficient and turbidity. These two parameters indicated that water clarity was highest in the river in spring and in the Hunting Creek embayment in late summer/early fall.

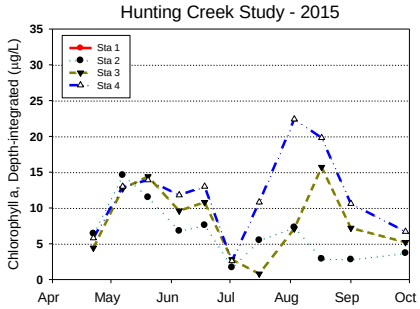
Ammonia nitrogen showed a strong seasonal pattern with a decline in early May followed by a clear increase into June and then a decline to much lower values in late summer and fall. Nitrate nitrogen showed a clear seasonal decline at all sites from values of about 1.0 mg/L in spring to levels below 0.5 mg/L in late summer, probably due to phytoplankton and macrophyte uptake. Nitrite exhibited a seasonal increase from April through June and then declined for the rest of the year. Organic nitrogen was mostly in the range 0.4-0.8 mg/L with little seasonal change. Total phosphorus was generally lower in the first half of the year and increased in the early July sample at the time of the runoff event. The increased values quickly dropped at most stations, but persisted at AR4. SRP declined steadily from April through August in response to higher demand from primary producers. N/P ratio consistently pointed to P limitation being greater than 7.2 at all times. TSS was generally 0-20 mg/L at all stations, but was elevated during the late June-early July runoff event at all stations.

As mentioned above a major event punctuated all of the seasonal patterns described above. This was the period of elevated tributary and river inflows in late June and into early July. During the period from June 17 to July 1, almost 22 cm (8.6 in) of rainfall was recorded at nearby National Airport and significant precipitation occurred in the Potomac watershed. Thus, large amounts of runoff passed into the study area. The result was marked changes in a number of water quality parameters in the July 2 monitoring run. These included water temperature, specific conductance, dissolved oxygen, pH, total alkalinity, secchi disk depth, light attenuation coefficient, turbidity, total phosphorus, N to P ratio, total suspended solids, volatile suspended solids, and chlorophyll a. Interestingly, most of these parameters recovered to pre-event levels on the next sampling two weeks later. Also interesting was that many nutrient parameters and biological variables did not change on that date.

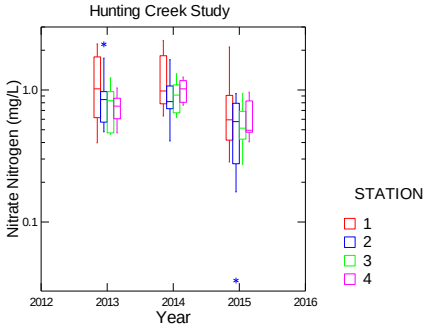


Chlorophyll exhibited a general seasonal pattern of increase in the spring which was ended by the late June-early July flow event. Following this event, chlorophyll increased in strongly in the river as phytoplankton rebounded there. The rebound was much weaker in the embayment due to competition with large SAV populations. Phytoplankton cell density was low, stable and similar at both stations from April through June, but

increased rapidly in July in the river and remained high. In Hunting Creek values increased only slightly through late July and then declined. Cyanobacteria were the most important contributors to cell density in both areas. *Oscillatoria* and *Chroococcus* were the most consistently important taxa at both stations. Phytoplankton biovolume exhibited a similar pattern of low values at both sites early in the year followed by a distinct increase in the river later in the year. Biovolume was strongly dominated by diatoms on most dates, but cryptophytes were also important and even dominant at times in the embayment. *Melosira* and discoid centrics stood out as major contributors among the diatoms with *Cryptomonas* and *Trachelomonas* being very important among the other algae.

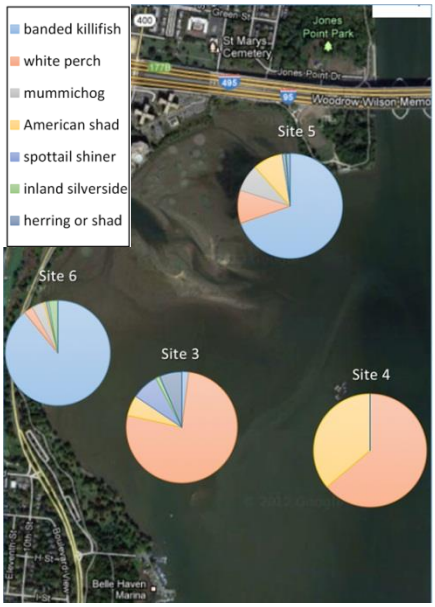


Rotifers were the most numerous zooplankton and on some dates attained high values. But there was more variation than normal. Most of the cladocerans found in the study area attained substantially lower densities than in previous years. Two groups became more apparent: *Camptocercus* and Macrothricidae were found in late August and early September in the embayment being stimulated by the SAV habitat. Copepod nauplii exhibited a variable pattern with a strong peak in late July in the embayment. Calanoid copepods were generally more abundant Hunting Creek in May and the river in June. Cyclopoid copepods were very generally more common in Hunting Creek than in the river except for one large peak in the river in late June. Oligochaetes were the most abundant invertebrates collected in these samples. Chironomid (midge) larvae made up the most of the remaining organisms at most stations. Gastropods and amphipods were also common.



Since three years of data are now available for the Hunting Creek Study, we conducted a comparison of years and stations as well as examining seasonal trends. Most parameters did not show a clear overall pattern when comparing the three years; those that did are here noted. There was a slight decline in dissolved oxygen values over the three years. Nitrate nitrogen was consistently lower in 2015 than in the previous two years. Nitrate nitrogen was lower in 2013 than the 2014 and 2015. N to P ratio trended downward slightly over the three years. Chloride also trended downward especially at AR1. Total cyanobacterial density, total phytoplankton biovolume and total diatom biovolume were higher in 2014 than the other years, especially at AR4. Copepods were also found at substantially higher densities in 2014. Many variables were found to have clear seasonal patterns. There were also differences among the stations in many cases.

The ichthyoplankton was dominated by the Family Clupeidae, which contains all herring and shad species, and represented over 90% of the total catch. The density of these clupeid larvae was at its peak in mid-May with a density of over 5,000 larvae per $10m^3$. Dominant species within this family were gizzard shad, which is a resident freshwater species, and alewife and blueback herring, which are anadromous shad (meaning that the adults live in marine water but travel to freshwater to spawn). Alewife is one of the focus species of our anadromous study in Cameron Run. While we cannot ascertain where exactly these larvae were spawned (Cameron Run or anywhere else in the Potomac watershed upstream of Hunting Creek), these high numbers are an encouraging finding for the Potomac River watershed spawning population of alewife. We did confirm that spawning occurs in Cameron Run, and a detailed report on our anadromous fish spawning study is included as part of this report. Of the larvae collected outside the Family Clupeidae, members of the genus *Morone* (striped bass or white perch) were dominant. Their production peak was in late May with a density of about 45 larvae per $10m^3$.



We collected a total of 921 adult and juvenile fish specimens comprising 24 species by trawling, which is similar in abundance as previous years, but higher in species numbers. White perch (*Morone americana*) was the overwhelming dominant in trawl collections in 2015 as opposed to 2014 when spottail shiner was most abundant. Seine collections yielded 2800 adult and juvenile fish specimens comprising at least 25 species, which is also similar to 2013. Like last year, the most abundant species by far was banded killifish (*Fundulus diaphonus*), comprising close to 80% of the catch. Other species that occurred at high abundance were mummichog (*Fundulus heteroclitus*), white perch and American shad. Overall, the fish community in Hunting Creek is typical of freshwater tidal tributaries in the Potomac River.

The spawning of anadromous clupeids was monitored in Cameron Run during their spawning season from mid-March to mid-May. Anadromous fishes such as river herring (collective name for alewife and blueback herring) migrate from the sea into freshwater to spawn. Cameron Run has several water control weirs blocking upstream access for anadromous fishes, so we collected our samples just downstream of the first weir. During the 10-week sampling period, we caught sixteen adult alewife. The abundance of river herring collected in 2015 was higher than 2014 (6 alewife and 1 blueback herring), which signifies the consistent use of Cameron Run as spawning ground. Extrapolating over the time sampled, this could mean that the alewife spawning population in 2015 was the size of 112 individuals (46 last year), which gives an average estimate of 79 individuals. These estimates will be improved with each consecutive sampling season. We recommend remaining with the current sampling location, and sample multiple consecutive year in the same location. We also found a total of 11 positively identified alewife larvae and 3 blueback herring larvae in plankton nets deployed in the run.

During 2015, the study of *Escherichia coli* in waters in the areas of Hunting Creek/Cameron Run and adjacent waters of the Potomac River was continued. A basic question being addressed is whether any of these waters are impaired under the Clean Water Act in terms of their designated uses. Samples were collected at eight sites in Hunting Creek, its tributaries, and the Potomac mainstem on six dates from June 30, 2014 to Sept 10, 2014. Eighteen percent of samples from AR10 were above 235 per 100ml, as were 36% of samples from station AR3, 45% from AR2, 54% from AR1, AR11 and AR12 and 100% of samples from AR13.The data support a conclusion that the lower portion of Cameron Run, the upper parts of Hunting Creek and Hoof's Run are impaired for the bacteriological water quality criterion (*E. coli*) content under Section 9VAC25-260-170 of the Virginia Water Quality Standards that applies to primary contact recreational use surface waters. The Potomac River samples and offshore Hunting Creek sample did not show evidence of impairment for *E. coli*.

The ecological survey of micropollutants in alluvial sediments and water from Hunting Creek continued in 2015. Water and alluvial sediments collected in the vicinity of the Hunting Creek embayment of the Potomac River were analyzed for micropollutants associated with urban sources. The objectives of the present investigation include the following considerations:

- Quantify the concentrations of micropollutants in sediments and water in the Hunting Creek region of the Potomac River.
- Expand the list of target compounds from the 2014 micropollutant analysis to include addition classes of emerging contaminants using both gas chromatography and liquid chromatography coupled with mass spectrometry.
- Determine the presence and concentrations target analyte metabolites.

No background levels of analytes were found in any of the laboratory of field blanks indicating that the glassware, filtration and extraction devices, SPE cartridges and instrument components or field contamination did not contribute to any of the concentrations reported. Most noteworthy in the results are the Endocrine Disrupting Compounds triclosan which ranged from 2.2 to 23.1 ng L^{-1}, and its biotransformation product triclosan methyl which ranged from 2.4 to 20.6 ng L^{-1}. Most notable was the concentrations for prednisone, an immunosuppressant drug used against numerous inflammatory diseases, with concentrations ranged from 208 to 1,468 ng L^{-1}. There are several notable pharmaceutical and personal care product micropollutants were found including the ubiquitous caffeine, acetaminophen, the insect repellant DEET, the sunscreen agent PABA and the sulfonamide antibiotics sulfathiazole and sulfamethoxazole.

We recommend that:

1. The basic ecosystem monitoring should continue. A range of climatic conditions is needed to effectively establish baseline conditions in Hunting Creek. Interannual, seasonal and spatial patterns are starting to appear, but need validation with future years's data.

2. Water quality mapping should be continued. This provides much needed spatial resolution of water quality patterns as well as allowing mapping of SAV distributions.
3. Anadromous fish sampling is an important part of this monitoring program and has gained interest now that the stock of river herring has collapsed, and a moratorium on these taxa has been established in 2012. The discovery of river herring spawning in Cameron Run increases the importance of continuing studies of anadromous fish in the study area.
4. We recommend that micropollutant sampling and analysis work be continued to better understand the source of residues observed in the Hunting Creek area.
5. We recommend a review of *E. coli* sampling plan and potential intensification of sampling sites in the Hooff Run area. We also recommend macroinvertebrate studies in this area and other tributaries to ascertain overall aquatic biota health.

List of Abbreviations

BOD	Biochemical oxygen demand
cfs	cubic feet per second
DO	Dissolved oxygen
ha	hectare
l	liter
LOWESS	locally weighted sum of squares trend line
m	meter
mg	milligram
MGD	Million gallons per day
NS	not statistically significant
NTU	Nephelometric turbidity units
SAV	Submersed aquatic vegetation
SRP	Soluble reactive phosphorus
TP	Total phosphorus
TSS	Total suspended solids
um	micrometer
VSS	Volatile suspended solids
#	number