I. INTRODUCTION

Bacterial Source Tracking (BST) with Antibiotic Resistance Analysis (ARA) was used to determine the potential sources of pollution in both the Coan River Watershed and the Little Wicomico River Watershed. Both rivers are located in Virginia’s Northern Neck, Northumberland County. Northumberland County was established in 1648, and is a peninsula that borders the Potomac and Rappahannock Rivers and the Chesapeake Bay. Northumberland County’s 570 square kilometers (220 square miles) consists mainly of flat to gently rolling countryside bounded by 705 kilometers (438 miles) of shoreline on inlets, creeks, the Potomac River and the Chesapeake Bay (Northumberland County Chamber of Commerce, 2003).

The Coan River Watershed empties into the lower Potomac River near Caliao and the Little Wicomico River Watershed empties into the Chesapeake Bay at Smith Point, where the Potomac River and Chesapeake Bay combine. The survey area consists of 59.268 square kilometers (22.885 square miles) for the Coan River and 39.171 square kilometers (15.125 square miles) for the Little Wicomico River. The Division of Shellfish Sanitation established these survey boundaries. Both rivers are polluted with fecal matter, and contain shellfish beds that have been closed because of high levels of fecal coliforms. The standard set by the government is 14 isolates per 100 milliliters. The shellfish water station only has to exceed the standard once a year to be placed on the impaired list. Forty two percent of the 180 unknown isolates collected from the Division of Shellfish Sanitation (DSS) stations exceeded the state shellfish standard of 14, which means there was a 42% failure between the two rivers.
Bivalve molluscan shellfish are (oysters, clams, mussels, etc.) feed by pumping large amounts of water through their gills and filtering out their microscopic-sized food particles. Along with these particles they also filter out bacteria and viruses from the overlying water (Virginia Department of Health, 2002). Shellfish have a long history as vectors of infectious and sometimes dangerous diseases, ranging from typhoid fever and hepatitis to diarrhea and minor intestinal disorders. Since these shellfish may be eaten raw, which includes their intestinal tract, care has to be taken to ensure that shellfish harvested for direct marketing are taken from very clean water. Waters approved for the direct harvest of shellfish therefore must be much cleaner than waters approved for swimming, fishing, etc.

Division of Shellfish Sanitation classifies shellfish waters using the requirements and standards of the National Shellfish Sanitation Program (NSSP). Virginia’s shellfish program must conform to the NSSP in order for its shellfish industry to engage in interstate commerce. Caution must be taken in swimming, fishing, and other recreational activities where fecal contamination is present. Shoreline surveys have been taken to examine sources of pollution capable of impacting the shellfish waters. The Virginia Department of Health has also conducted surveys of failing septic systems as well as locating the septic fields and surveying septic tanks (Virginia Department of Health, 2002).

The Division first determines the proper classification of shellfish waters is to conduct a shoreline survey. In order to correctly classify shellfish waters as to their suitability for the direct marketing of shellfish, the watershed must be examined for the presence of actual and potential sources of pollution.
The survey involves visiting all properties on the drainage basin of the area that is deemed capable of impacting shellfish waters. The primary concern is the presence of fresh fecal matter. All onsite sewage facilities are investigated to see if they are functioning properly, and all potential sources of other pollution including animal waste, toxic substances, industrial discharges, marinas, wastewater treatment facilities, etc. are inspected. Sewered areas are noted, but not investigated. The field data and other pertinent information are compiled into a report accompanied by a map of the area (Virginia Department of Health, 2002). DSS investigates an average of over 13,000 properties per year, and conducts new shoreline surveys every 6 to 8 years.

The objectives of my study were to: (1) monitor the shellfish embayments in the Coan River Watershed and the Little Wicomico River Watershed and determine their level of impairment, (2) develop a known source *E. coli* library for both watersheds, and (3) use a phenotypic bacterial source tracking technique called antibiotic resistance analysis on water samples from both rivers to identify sources of fecal pollution. The Virginia Division of Shellfish Sanitation conducted the sampling and monitoring was performed with help from Dr. Howard Kator at the Virginia Institute of Marine Sciences. The known source library was developed using 1,248 *E. coli* isolates from 12 different human and animal sources and the library was used along, with antibiotic resistance analysis, to determine the sources of *E. coli* isolates in water samples from the Coan River Watershed and the Little Wicomico River Watershed.