REVIEW OF AVAILABLE DATA ON TYPES OF CANCER RELATED TO ARSENIC EXPOSURE: VASHON-MAURY ISLAND, WASHINGTON STATE AND WASHINGTON STATE COUNTIES 1980-1998

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EXECUTIVE SUMMARY

This report is a follow-up to a July, 2000 report on arsenic, cadmium and lead contamination of soils on Vashon-Maury Island (VMI) and the nearby areas of the mainland. It is a review of available cancer incidence (defined as new cases) and mortality (deaths) data for types of cancer that have been related to arsenic exposure. The objectives of this report are to present the rates of these cancer types on VMI, to compare them to the rates of cancers occurring elsewhere in Washington State, and to evaluate the differences for patterns that would indicate increased risk for residents of VMI.

The cancer types examined include cancer of the lung, bladder, and non-melanoma skin (for these types, there is strong evidence in the scientific literature for arsenic causation), as well as kidney, liver, and prostate cancer (for these types, statistical relationships with arsenic exposure have been reported but a causal link is not established). We analyzed each type of cancer individually, all types combined, and lung and bladder cancer combined, because of the stronger evidence connecting these cancer types to arsenic exposure. (One non-melanoma skin cancer death was recorded on VMI from 1980-1998, and skin cancer cases not resulting in death are not recorded in Washington State, so they were not included in this category.)

Incidence data were available for 1992 to 1998 and mortality data were available from 1980 to 1998 from the Washington State Department of Health. The years spanning the time period were combined to increase sample size to calculate rates that were as stable as possible. Rates on VMI were compared to rates for Washington State, King County and all other counties in Washington State. The rates for all cancer types combined on North Vashon Island were also compared to the rates for South Vashon-Maury Island, because previous studies showed that the potential for exposure to environmental arsenic in soil and air was higher on South Vashon-Maury Island.

Mortality data back to 1968 is available; however, data from these earlier years have not been in widespread use, and questions about the quality of variables (for instance, decedent address) and a change in the death coding scheme would need to be explored before reliable analyses could be carried out. In addition, the detailed population estimates for VMI that are used in calculation of rates would need to be generated for this time period. Therefore, we restricted our analysis to the mortality dataset from 1980 on, which has been in wide use for several years.

Cancer rates are subject to random fluctuation or variation. Generally, the smaller the population and number of cases or deaths, the greater the random variation. We used statistical tests to see whether differences in rates were more than would be expected from random variation alone (i.e., to see whether the differences were statistically significant).

When comparing rates, no statistically significant differences were found between VMI and the state as a whole or King County. VMI showed mortality rates that were significantly higher than in San Juan County for all types combined, lung and bladder combined and lung cancer alone. These differences were mainly due to lung cancer mortality, which made up 71% of the total of cancer deaths examined on VMI. The San Juan County lung cancer mortality rate was statistically significantly lower than those in 33 of the other 38 counties (including King County), and lower than the rate in Washington State as a whole. In addition, the incidence rate for lung cancer on VMI was statistically significantly lower than for Grays Harbor and Mason Counties. A comparison of cancer rates in North Vashon Island and South Vashon-Maury Island also failed to show any statistically significant differences, but did weakly suggest higher lung cancer incidence and mortality rates on North Vashon Island. Based on these findings, it is not likely that the differences seen regarding lung cancer were mainly due to exposure to environmental arsenic.

VMI ranked 17th of the 41 areas used in the comparisons--39 counties, Washington State and VMI--in cancer incidence, and 21st in cancer mortality, for all the cancer types combined (a rank of 1 would represent the highest rate). Rankings for specific cancer types were highly variable, ranging from a rank of 1 for prostate cancer mortality to a rank of 36 for lung cancer incidence. The prostate cancer finding may be of concern but is difficult to interpret from the data available (a total of 26 deaths in the 19-year period between 1980 and 1998).

While the prostate cancer findings were not statistically significant, we gave some additional thought as to whether they are reason for concern. There are several considerations that tend to lessen our concern. First, the incidence rate of prostate cancer is within the range of that of many other counties. Therefore, while on the high side, the incidence rate is not unusual. Although the death rate is higher than other death rates for prostate cancer, it is based on 26 deaths over an 18-year period. The rate is subject to a relatively large amount of random variation, so it is difficult to determine whether this is a chance finding or whether it is related to factors such as access to quality medical care, exposure to environmental toxins or other factors. With diseases like prostate cancer, whose causes are largely unknown, interpretation of statistically non-significant findings based on small numbers of deaths is difficult and is largely a matter of conjecture.

However, limitations in the study datasets--especially the small number of health events on VMI and the lack of information on detailed exposure to arsenic--limit the conclusions that can be drawn about excess risk. In general, the smaller the number of deaths or cases involved in the comparison areas, the larger the observed differences need to be to rule out random variation as a cause of the difference. In addition, the lack of detailed exposure information means that true "exposed" and "unexposed" populations cannot be assembled for comparison. Thus, although this analysis probably rules out a very large increase in cancer risk to the population of VMI, the study is not sensitive enough to detect a smaller increase in risk.

Arsenic is a known human carcinogen. The epidemiological literature has shown increased cancers from high exposures and mathematical models used by the US Environmental Protection Agency predict increased cancers from lower exposures to arsenic. For this reason, Public Health continues to recommend that residents take prudent steps to minimize their exposure to arsenic in soil, as discussed in the Frequently Asked Questions section of the Soil Study Summary and Support Information, found on the following web address: http://www.metrokc.gov/health/hazard/soilsamples.htm. This document can also be obtained by telephoning Public Health at (206) 296-4692.

The design of this study and its results have been reviewed by members of VMI community; and staff at Public Health, the Washington State Department of Health and Department of Ecology. We wish to thank the reviewers for their time, expertise and comments.

I. Introduction and Background

This report analyzes cancer rates on Vashon-Maury Island (VMI) for the types of cancer that might result from exposure to inorganic arsenic through ingestion or inhalation. The current report is a follow-up to an earlier report, issued by Public Health in July 2000, documenting elevated concentrations of arsenic, cadmium and lead in the near-surface soils of VMI and a limited area on the nearby King County mainland.[1] A 1992 Environmental Protection Agency exposure assessment of the Commencement Bay Superfund Site related to the Tacoma smelter, ingestion was identified as the primary route of exposure to arsenic found in soils.[2] In addition, the EPA report summarized studies of stack emissions, including arsenic, from the Tacoma smelter,[2] and a report from the Puget Sound Air Pollution Control Agency suggested that the smelter plume extended to VMI.[3] Thus, we reasoned that exposure to arsenic among VMI residents may have resulted from both ingestion of soil arsenic (up to the present) and inhalation of airborne arsenic (at least until 1985, when the Tacoma smelter ceased operations).

The July report found a wide range of contamination levels, ranging from background cadmium levels to substantial elevations (one-to-two orders of magnitude above background for arsenic and lead). Arsenic and lead contamination ranged up to 460 ppm (parts per million) and 1300 ppm, respectively. The July soil study also found that the arsenic and lead soil levels were highest on Maury Island and South Vashon Island (Zone 1 in the study), followed by the mainland (Zone 2) and North Vashon Island (Zone 3).

Because only undisturbed soils were sampled, we believe these levels represent the upper range of soil contamination on the island. The soil sampling report (as well as this report) can be found on the World Wide Web at **www.metrokc.gov/health/**, or by contacting Public Health by e-mail at maury-vashon.soils@metrokc.gov or by telephone at (206) 296-4692.

A range of activities, including community education and mobilization, further soil assessments, childhood lead testing and a review of available health data were initiated as a response to the report's findings and to community concerns. The current report is a review of cancer data for VMI for the types of cancer that, according to the epidemiological literature, have been associated with ingestion and inhalation of inorganic arsenic. (In this report, "arsenic" refers to "inorganic arsenic". Ingestion of organic arsenic is not believed to be a health risk.) Lead exposure at the levels found on VMI is not thought to be a problem in adults, and blood tests of VMI children for lead have been normal to date. Thus, the remainder of this report focuses on cancers associated with exposure to arsenic.

Objective and Focus: The objective of this health data review is to use available cancer data to describe the risk to Vashon-Maury Islanders of the types of cancer associated with exposure inorganic arsenic. Exposure to inorganic arsenic could have occurred over the last 20 or more years, the latency period[1] of most cancers, through inhalation of airborne arsenic (in the past) or through ingestion of soils containing arsenic (through the present). To see whether risks seem abnormally high, rates for the same cancers were compared between VMI, Washington State overall and for the counties in Washington State. The rates are adjusted for age differences in these populations.

In this report, we have chosen to focus on cancer. Long-term arsenic ingestion is also associated with other chronic illnesses, such as peripheral vascular disease or hypertensive heart disease (see

[1] Latency period is the time between exposure and diagnosis of disease. The latency period of many cancers can range up to 20 years or more.

Appendix C, Health Effects of Arsenic Exposure below for a more detailed summary). We focused on cancer because the available cancer data were more comprehensive than the available data on other conditions, since it includes both new cases and deaths, and therefore is probably more likely to show differences between populations if they exist. Local data on both cancer deaths and new cases is of high quality and readily available. Washington State has a mandatory reporting system for cancer and all new cases of cancer among Washington residents are reported to the Washington State Cancer Registry (WSCR) at the state Department of Health. Cancer deaths (and all deaths) must be reported to the Center for Health Statistics at the state Department of Health. (For a detailed discussion of the data sources, please see Appendix A.) There are no mandatory reporting systems currently in place for the incidence of illnesses such as peripheral vascular disease or hypertensive heart disease, although deaths data are available. Thus, looking at new cases for these diseases would require active fieldwork to identify case rates on VMI and rates in a comparison area. This type of fieldwork is generally undertaken only after assessment using previously collected data.

Similar analyses were carried out for incidence and mortality data, using all available years of each dataset. Each cancer type was looked at individually (see Methods section for details on the design). Lung and bladder cancers were also examined together because the evidence connecting these two types to arsenic ingestion is stronger than for the other types. In addition, all types combined were analyzed.

Cancer cases and cancer deaths files do not necessarily include the same people, because decedents may have been diagnosed with cancer (and thus reported as new cases) in a different area from where they died.

The balance of this report is organized into the following sections:

- Section II: Methods, describes the sources of available cancer data and the methods used to prepare and analyze this information
- Section III: Results, summarizes the results of the analysis of cancer rates for VMI and the comparisons to other parts of Washington State.
- Section IV: Discussion and Interpretation, provides interpretation for the results and highlights unusual or noteworthy findings
- Section V: Limitations, describes limitations related to the sources of the data, the sample size and model-based risk assessment of arsenic exposure imposed on the interpretation of the data
- Section VI: Summary and Conclusions
- Appendix A: Sources of Data
- Appendix B: Geocoding
- Appendix C: Health Effects of Ingestion of Inorganic Arsenic
- Appendix D: Results (Detailed Description)

II. Method

Data Sources

We analyzed cancer data from mortality (deaths) and incidence (new cases) datasets. Deaths statistical files were provided by the Center for Health Statistics at the State Department of Health (DOH), and statistical files for incidence were provided by the DOH Washington State Cancer Registry. From the cancer registry, we were able to obtain patient information, such as where the person lived when s/he was diagnosed, age and sex, and medical information, such as type of cancer and date of diagnosis, for all newly diagnosed cancers. The deaths files included address, age, sex, date of death and underlying cause of death. Please see Appendix A for a detailed discussion of data sources.

Types of Cancer Included

Based on a recent comprehensive literature review from the National Academy of Sciences (NAS),[4] we selected the following cancers associated with arsenic exposure for examination: lung, bladder, prostate, kidney, angiosarcoma of the liver and non-melanoma skin cancers (see Appendix C for a more detailed summary of the health effects of exposure to arsenic). We analyzed each cancer type separately and all of them combined. Because the NAS report identified strong evidence that arsenic exposure causes non-melanoma skin cancer, lung cancer and bladder cancer, we also looked at lung and bladder cancers combined where the data were available. (Non-melanoma skin cancer is not reported to the cancer registry.)

Not all cancer types were available from all datasets. For instance, deaths data could identify liver cancer as a whole, but not angiosarcomas, a small subset of liver cancer. Also, the cancer registry does not include the non-melanoma skin cancers that are associated with arsenic ingestion, unless they are located on the external genital organs. Please see Appendix A, Data Sources and Tables A-1 and A-2 for a more detailed discussion of the coding schemes used for deaths and incidence data.

Data Preparation

All deaths and new cases were assigned a county code based on the residential address recorded in the files in a process known as *geocoding*. In addition, residential address was used to assign cases and deaths to a Vashon-Maury Island (VMI) census tract. Address data were sufficient to assign a census tract on VMI if it was recorded in 1990 or after. Address data recorded from 1980 to 1989 could be used to assign to VMI as a whole, but in most cases these addresses were not sufficient to reliably assign them to a census tract within the island. This is because almost all VMI addresses were given as rural routes and Post Office boxes from 1980 to 1989. As a result, analyses comparing rates in North Vashon (census tract 277.01) to South Vashon-Maury Island (census tract 277.02) were limited to the years 1990 and after (see Figure 1 for a map of census tracts on VMI).

For the years 1990 and after, most addresses could be geocoded to the census tract level. Cancer incidence data were available from 1992 to 1998. Out of 130 total cases of the selected cancer types diagnosed on VMI from 1992-1998, 12 could not be assigned to a specific census tract or block group because of insufficient address information. Death data are available from 1980 to 1998. Out of 68 deaths that occurred between 1990 and 1998, three could not be geocoded to a specific census tract because of insufficient address information.

For a detailed discussion of the geocoding process, please see Appendix B.

Data Analysis

Time Period and Comparisons

The following points apply to both the mortality (death) and incidence (new cases) analyses.

- All available years of mortality and incidence data were included.
  - High-quality mortality data and small area population estimates are available from the state Department of Health (DOH) for 1980-1998.
  - Mortality data back to 1968 is available; however, data from these earlier years have not been in widespread use, and questions about the quality of variables (for instance, decedent address) and a change in the death coding scheme would need to be explored before reliable analyses could be carried out. In addition, the detailed population estimates for VMI that are used in calculation of rates would need to be generated for this time period. Therefore, we restricted our analysis to the mortality dataset from 1980 on, which has been in wide use for several years.
  - The Washington State Cancer Registry is available from DOH. The registry was begun in 1992. Cancer cases from earlier years would need to be requested by DOH from the Fred Hutchinson Cancer Research Center Cancer Surveillance System (CSS) if a follow-up analysis is needed. CSS is a registry of the cancer cases that develop in the people who live in 13 counties in western Washington State.
- We compared the rates for residents of VMI to rates for residents of all other counties and for Washington State overall.
- Cancer incidence and mortality rates for South Vashon-Maury (census tract 277.02) were compared to North Vashon (census tract 277.01) for all available years (see Figure 1 for a map of census tracts on VMI).
- Because cancer rates generally increase as age increases, the rates were adjusted for age differences in the populations included.
- Ninety-five percent confidence limits were calculated for all rates. Rates for small areas tend to vary because of chance alone; confidence limits are a measure of the amount of random variation of the rate. (See next bullet for how 95% confidence intervals were used.)
- The differences between rates were evaluated to see whether they were statistically significant. For rates that are statistically significantly different, chance variation can be ruled out as a reason for the difference with 95% certainty. In our analysis, if 95% confidence limits did not overlap for two rates, the rates were statistically significantly different. For instance, the lung cancer incidence rate on VMI was 60.3 per 100,000, with 95% confidence limits of 43.2 and 77.4 (see Table 4). The rate for Grays Harbor was 103.2 per 100,000, with 95% confidence limits of 94.9 and 111.5. Because the lower limit for Grays Harbor (94.9) exceeded the upper limit for Vashon Island (77.4), the rate for Grays Harbor was statistically significantly higher. Significant differences, if any, were noted in all tables and in the Results section in the following pages.

The following analyses were carried out for cancer incidence: We aggregated data from the years 1992 to 1998 to provide rates that were as stable as possible. The following analyses were carried out:

- Compare VMI to Washington State for 1992-1998.
- Compare VMI to each Washington State county for 1992-1998.

- Compare South Vashon-Maury Island to North Vashon Island for 1992-1998 (see Figure 1).

The following analyses were carried out for cancer deaths: We combined data from the years 1980-1998, and also analyzed 1980-1989 and 1990-1998 as separate periods to look for differences. The following analyses were carried out:

- Compare VMI to Washington State for 1980-1998, 1980-1989 and 1990-1998.
- Compare VMI to each Washington State county for 1980-1998, 1980-1989 and 1990-1998.
- Compare South Vashon-Maury Island (Census Tract 277.02) to North Vashon Island (Census Tract 277.01) for 1990-1998. Addresses for deaths occurring before 1990 could not be geocoded to census tract within VMI (see Geocoding section for details). See Figure 1 for a map of census tracts on VMI.

III. Results (Summary)

The following section is a summary of the results of the major analyses. A detailed description of these results may be found in Appendix D. Please see Appendix D, Table D-1, for a summary of the comparisons carried out for this report, and refer to Tables D2-D23 for the specific analyses.

Between 1992 and 1998, there were 130 lung, bladder, prostate and kidney cancers diagnosed among Vashon-Maury Island (VMI) residents. No cases of angiosarcoma of the liver were diagnosed in VMI residents during this period. Between 1980 and 1998, there were 137 deaths from cancer of the lung, bladder, prostate, kidney, liver and skin (non-melanoma).

Statistically Significant Differences

No differences between VMI and King County or Washington State were statistically significant.

When the VMI rates were compared to each of Washington State's 38 other counties, very few were found to statistically significantly differ from the VMI rates. VMI mortality rates were significantly higher than those in San Juan County for all examined cancer types combined (Table D12), for lung and bladder cancer combined (Table D15) and for lung cancer alone (Table D16). These differences were driven by lung cancer mortality, which made up 71% of the cancer deaths on VMI (Table D11). For lung cancer mortality, San Juan County ranked last and showed rates significantly lower than those in 33 other counties in Washington State, and was lower than Washington State as a whole.

For cancer incidence, there were very few significant differences with county rates. The only significant difference was in lung and bladder cancer combined (Table D4) and lung cancer alone (Table D5), where VMI showed significantly lower rates than Grays Harbor and Mason Counties. These counties rank 1 and 2 in Washington State for lung cancer and lung and bladder cancer combined.

There were no significant differences between North and South Vashon-Maury Island for incidence (Table D9) or mortality (Table D22) for all the types of cancers we examined. However, the death rates for all cancers combined on North Vashon were almost double the rates on South Vashon-Maury, while the incidence rates were slightly higher on South Vashon-Maury.

We followed up by looking at the North-South difference in each cancer type. This showed that both lung cancer mortality and incidence was nonsignificantly elevated in North Vashon (Table D23). The results for the other cancer types were mixed, with incidence and mortality showing different patterns. For instance, prostate cancer incidence was non-significantly higher on South Vashon-Maury Island, while prostate cancer mortality was non-significantly higher on North Vashon Island.

The North-South difference in total cancer mortality was driven by the difference in lung cancer mortality. Lung cancer is the most lethal of the cancer types studied, accounting for 71% of the cancer deaths included. In contrast, lung cancer incidence (new cases) makes up less than one-third of total incidence. Thus, the lung cancer mortality difference between north and south Vashon profoundly influenced the all-cancer-types mortality difference. The lung cancer incidence difference exerted much less influence on the all-cancer-types incidence difference.

Prostate Cancer Mortality and Incidence

The prostate cancer mortality rate on VMI (49.5 per 100,000, based on 26 deaths) ranked first (highest) among the counties and Washington State (Table D18), and was substantially higher than the King County rate (35.8 per 100,000) and the Washington State rate (35.0 per 100,000). The prostate cancer incidence rate on VMI (211.5 per 100,000, based on 66 cases) ranked 8th among the counties and was higher than the rate for King County (168.9 per 100,000) and Washington State (176.3 per 100,000). However, because of the small number of deaths and cases, the rate was not statistically significantly different from any other county or Washington State (i.e., random variation in incidence and mortality rates cannot be ruled out as the cause of this difference).

An analysis of prostate cancer incidence and mortality on North Vashon and South Vashon-Maury Island showed mixed and inconclusive results. Prostate cancer incidence was higher on South Vashon-Maury Island (225.8 per 100,000, based on 33 cases) compared to North Vashon Island (158.3 per 100,000, based on 27 cases); however, the prostate cancer mortality rate on North Vashon (71.1 per 100,000, based on 9 deaths) were higher than the mortality rate on South Vashon-Maury island 32.6 per 100,000, based on 5 deaths). None of the differences in mortality or incidence between North and South Vashon were statistically significant.

IV. Discussion and Interpretation

In evaluating the results of the study, we first looked for statistically significant results. We also closely examined any results that seemed noteworthy. Thus, the discussion below involves the lung cancer mortality finding (a statistically significant difference) and prostate cancer mortality and incidence findings (a noteworthy result that was not statistically significant).

Lung Cancer Mortality

Very few mortality and incidence comparisons between VMI and the counties or state were statistically significant. Mortality rates for all-selected-cancer types combined, for lung and bladder cancer combined, and for lung cancer alone on VMI were elevated compared to one county (San Juan County). The underlying elevation driving these comparisons is mostly the elevation of lung cancer mortality on VMI compared to San Juan County.

Some characteristics of the two areas facilitate the comparison of VMI and San Juan Island rates. Data from the 1990 U.S. Census indicate that the two areas are very similar demographically, with poverty rates well below the state average, similar median household incomes, the proportion of adults without a high school education lower than the state average, and (from current population estimates) a relatively small population of racial and ethnic minorities.[5]

Other differences, however, strongly suggest that factors other than exposure to environmental arsenic underlie the difference in lung cancer mortality rates. We have outlined these factors below. On balance, the fact that VMI's lung cancer mortality rates are higher than those for San Juan Island is very probably not caused by exposure to environmental arsenic, but is more likely a reflection of San Juan County's unusually low mortality rates overall.

Residents of VMI—20 minutes by ferry from Seattle—obviously have stronger ties to a major metropolitan area than does San Juan County. More rapid and frequent ferry service and a higher ratio of physicians to population in King County suggest greater access to health care providers. As of September 2000, King County's ratio of licensed active physicians to population was 3.8 per 1000 population, while San Juan County's ratio was 2.9 per 1000.[6] According to the Washington State Department of Transportation Summer 2000 ferry schedules, ferries run between Seattle and VMI up to 27 times per day, with a minimum 20-minute crossing time. Fewer than 20 ferries per day run between San Juan County and the mainland (and few of these stop at every island in the county, further limiting opportunities to travel between the mainland and a particular island), and the minimum crossing time is 50 minutes. Because of the popularity of the San Juans as a summer vacation destination, ferry lines for those traveling to and from the mainland by auto can be long. Because the San Juans are generally more remote from health care providers, people living in San Juan County who are diagnosed with lung cancer and other diseases may move to an area with greater access to providers, and this movement may artificially depress the death rate seen in this county.

In addition, people living in San Juan County may be among the healthiest in the state: a separate analysis of the 10 leading causes of death in Washington State counties over the last five available years of data showed that, for seven of the leading causes of death (including the three leading causes—heart disease, all cancer and stroke), San Juan County had the lowest or next-to-lowest rate among the counties. (This analysis is not included in this report but is available on request.) San Juan County has the lowest all-cause mortality rate of all Washington State counties. In the lung cancer mortality analysis, the rate for San Juan County was significantly lower than 33 of the state's 39 counties, including King County.

Finally, if the elevation in VMI lung cancer mortality rates compared to San Juan County was due to exposure to environmental arsenic, we would expect that the lung cancer death rate in people living in South Vashon-Maury would be elevated compared to the San Juan rate. However, the lung cancer mortality rate for South VMI (34.1 per 100,000) and San Juan County (34.7 per 100,000) are very similar.

Also, lung cancer incidence and mortality rates were higher in North Vashon compared to South Vashon-Maury, although these differences were not statistically significant. The higher rate found in North Vashon compared to South Vashon-Maury suggests exposure to environmental arsenic is not a causal factor. Finally, a smoking history was mentioned in over 70% of the lung cancer deaths in both North and South Vashon-Maury Island (analysis not shown but available on request), showing a dominant role of tobacco involvement in the lung cancer deaths.

Prostate Cancer Mortality and Incidence

Prostate cancer mortality and incidence on VMI were non-significantly elevated compared to Washington State and King County, and prostate cancer mortality ranked highest among all counties. Increased prostate cancer risk has been reported in some studies of populations exposed to high levels of arsenic in drinking water.[4] In addition, exposure to cadmium has been linked with increased risk of prostate cancer, chiefly through studies of workers who were occupationally exposed to cadmium.[7] Cadmium was also found above background levels in VMI; soil concentration of cadmium and arsenic were found to be highly correlated.[1]

While the prostate cancer findings were not statistically significant, we gave some additional thought as to whether they are reason for concern. There are several considerations that tend to lessen our concern. First, the incidence rate of prostate cancer is within the range of that of many other counties. Therefore, while on the high side, the incidence rate is not unusual. Although the death rate is higher than other death rates for prostate cancer, it is based on 26 deaths over an 18-year period. The rate is subject to a relatively large amount of random variation, so it is difficult to determine whether this is a chance finding or whether it is related to factors such as access to quality medical care, exposure to environmental toxins or other factors. With diseases like prostate cancer, whose causes are largely unknown, interpretation of statistically non-significant findings based on small numbers of deaths is difficult and is largely a matter of conjecture.

In summary, a review of the cancer mortality and incidence data on VMI, and in Washington State and its counties does not suggest a pattern of high rates of arsenic-related cancers on VMI. The practical value of this finding is that the existence of extremely high risk from arsenic exposure is probably ruled out. Because of limitations of the study, the results do not rule out a smaller elevation in arsenic-related cancer risk. These limitations are discussed below.

V. Limitations

There are three important limitations to this analysis: (1) Lack of detailed information on the amount of exposure to arsenic (2) limited capacity to detect smaller increases in risk, and (3) the presence of other important risk factors for the cancer types that were included. Taken together, these points fundamentally limit the conclusions that can be drawn by the lack of unusually high rates of arsenic-related cancers found on VMI. The limitations are described in more detail below.

Lack of detailed exposure information: The lack of detailed information on the amount of exposure to arsenic means that true "exposed" and "unexposed" populations cannot be assembled for comparison. The only available data on exposure is whether, at time of diagnosis or death, the cancer case or decedent resided on Vashon-Maury Island (VMI). The cancer mortality and incidence datasets do not include information on length of residence (and thus length of exposure); other possible environmental or occupational exposure to arsenic; individual sensitivity to arsenic; family history of cancer; or exposures to other substances that could cause these cancers (with the exception of tobacco use in mortality files, as discussed above). This limitation could either artificially lower or increase VMI cancer rates in this analysis.

In addition, using residence at time of cancer diagnosis or death as an indicator of exposure can result in misclassifying whether a person has been exposed or not exposed to environmental arsenic. If arsenic exposure on VMI *was* causing cancer, people whose cancers were caused by exposure on VMI and who moved off the island would be lost to the VMI cancer counts. Others who moved onto the island and who did not have this historical exposure would be less likely to develop an arsenic-related cancer (all other factors being equal). This would artificially lessen differences between VMI and other counties in cancer rates.

Also, the boundary used in the North Vashon Island-South Vashon-Maury Island analysis probably does not precisely follow zones of high and low exposure. The South Vashon-Maury Island area (Census Tract 277.02) clearly includes some soil arsenic concentrations similar to those found on North Vashon Island. If the distribution of soil arsenic concentrations is an accurate marker for the extent of historical and current exposure in the population, exposure status would be misclassified in some people. This would also artificially lessen our ability to detect exposure-related differences in cancer rates between the two areas.

Limited capacity to detect smaller increases in risk: Because the population of VMI is relatively small, the statistical sensitivity of this study to detect differences with other geographic areas is limited. We carried out a separate analysis to determine the limits of this study's statistical sensitivity. Our analysis addressed the question: what is the minimum increase in the number of deaths that would be statistically significant?

For this analysis, we assumed Washington State as a whole had normal death rates for the cancers in this study. We calculated the expected number of deaths on VMI by applying Washington State death rates to the VMI population, controlled for age and sex. Thus, the expected number of deaths on VMI is the number of deaths that would occur if the VMI population was dying at the same rate as the state's population.

This analysis showed that, from 1980 to 1998, 135 deaths from these cancers would be expected on VMI. There would have to be additional 25 deaths (an 18% increase) on VMI to generate a statistically significantly increase over the expected number. Thus, if there was an increase of below 18%, it would not be statistically significant and random variation could not be ruled out as

a reason for the difference. For differences involving smaller populations or specific cancer types, the difference would have to be greater to be statistically significant.

Other Risk Factors for Cancer: It is important to keep in mind that, other than angiosarcoma of the liver, each of the types of cancer that has been associated with arsenic exposure is also associated with many other risk factors. The major known risk factors for each cancer type are as follows:

Non-Melanoma Skin Cancer (Basal Cell Carcinoma or Squamous Cell Carcinoma): Exposure to ultraviolet radiation from the sun, exposure to ionizing radiation. Skin cancers may arise as complication of ulcers, burns and scars. Individual characteristics that increase the risk for skin cancer include white race, particularly Celtic heritage, the presence of precursor lesions, deficiencies in the immune system, and several rare hereditary diseases.

Lung Cancer: The major risk factor for lung cancer is cigarette smoking. Risk is also increased among those who smoke cigars or pipes, and those who are exposed to environmental tobacco smoke or radon. Occupational exposures to asbestos, chromium, ionizing radiation, polycyclic hydrocarbons, chloromethyl ethers, and mustard gas have been associated with increased risk for lung cancer. Certain lung diseases, such as tuberculosis and emphysema, also increase the risk.

Bladder Cancer: Bladder cancer occurs primarily among white men. The disease is twice as common among whites as among blacks, and the male to female ratio is at least three to one. Cigarette smoking is a major risk factor, and workers in the rubber, chemical and leather industries show increased risk, as well as hairdressers, machinists, metal workers, printers, painters, textile workers and truck drivers.

Kidney Cancer: Kidney cancer occurs most often between the ages of 50 and 70, and affects about twice as many men as women. It is more common among African-American men than among white men. Cigarette smoking is a risk factor, and obesity may be associated with increased risk in women. The use of phenacetin (a painkiller that is no longer sold in the US) has been clearly linked to tumors of the renal pelvis. Patients on long-term kidney dialysis have an increased risk of developing kidney cancer, as do patients with Von Hippel-Lindau disease, a rare genetic disorder.

Prostate Cancer: Prostate cancer is the most frequently diagnosed cancer among US men and ranks second after lung cancer as a cause of cancer deaths among US men. Prostate cancer occurs most frequently among men over age 55, and is more common among African-American men than among white men. It is less common among Asian men, although Asian men who have migrated to the US have a higher incidence of prostate cancer than native Asian men. Some evidence suggests that a diet high in fat increases the risk of prostate cancer. Other possible risk factors include higher levels of blood testosterone, benign prostatic disease, and exposure to cadmium during welding or battery manufacturing.

Section VI: Summary and Conclusions

This analysis of available incidence and mortality data on cancer types that have been associated with arsenic exposure (including cancer of the lung, bladder, kidney, liver, prostate and skin) did not find evidence that residents of VMI have a pattern of higher rates of these diseases, compared to other residents of Washington State. No significant differences were found comparing VMI with the state as a whole or with King County. Where statistically significant differences were found between VMI and other counties for lung cancer, the counties that differed from VMI tended to have the lowest rates (e.g., San Juan County) or the highest rates (e.g., Grays Harbor, Mason Counties) in the state. A comparison of cancer rates in North Vashon and South Vashon-Maury Island failed to show any statistically significant differences, but did suggest higher lung cancer incidence and mortality rates on North Vashon Island. However, South Vashon-Maury Island showed higher soil concentrations or arsenic in a 1999 soil survey,[1] which suggests higher exposure to South Vashon-Maury residents. For this reason, it is not likely that the differences seen regarding lung cancer were mainly due to exposure to environmental arsenic.

Prostate cancer mortality on VMI ranked highest among the counties. However, there are a number of reasons why we do not find this alarming. Prostate cancer incidence, while on the high side, is within the range of that found in many other counties. The prostate cancer mortality rate, based on a small number of deaths, is subject to a relatively large amount of random variation and was not statistically significantly different from any other county rates or the state rate. With diseases like prostate cancer, whose causes are largely unknown, interpretation of statistically non-significant findings based on small numbers of deaths is difficult and can largely be a matter of individual opinion.

However, the small population of VMI, the lack of detailed exposure information in available datasets and the presence of other major, well-known risk factors for these cancers limits the conclusions that can be drawn from the finding of no consistently elevated rates. Specifically, although this analysis probably rules out a very large increase in risk, the study is not sensitive enough to detect a smaller increase in cancer risk. Arsenic is a known human carcinogen. The epidemiological literature has shown and mathematical models predict increased cancer incidence from exposure to arsenic.

Further epidemiological studies of cancer morbidity and mortality would face several challenges. Mortality data back to 1968 is available; however, data from these earlier years have not been in widespread use, and questions about the quality of variables (for instance, decedent address) and a change in the death coding scheme would need to be explored before reliable analyses could be carried out. In addition, the detailed population estimates for VMI that are used in calculation of rates would need to be generated for this time period. Confidential cancer incidence data prior to 1992 could be requested from the Fred Hutchinson Cancer Research Center, but the dataset would require additional resources to retrieve, analyze and geocode. For other types of follow-up studies, the relatively small population of Vashon-Maury Island would still limit the power to detect statistically significant differences. In addition, the systematic collection of high-quality historical exposure information would be an intensive, technically challenging and expensive project, and such a study would also possibly not draw firm conclusions. A case-control study of lung cancer deaths near the Tacoma smelter that occurred when the smelter was in operation, where arsenic exposures were presumably greater than on VMI, had mixed results but, the authors concluded, argued “against large excess lung cancer risks for communities exposed to ambient arsenic.”[8]

Meanwhile, there is a wealth of existing, consistent evidence from other epidemiological studies that exposure to arsenic increases cancer risk, and that risk is related to duration and intensity of exposure. Whether or not further epidemiological studies were commissioned and completed, public health recommendations on decreasing risk would likely remain the same. Because of the uncertain result and the potential expenditure of large amounts of resources, Public Health does not recommend further cancer morbidity and mortality studies at this time, but we are certainly open to discussing this issue with community members.

Finally, Public Health recommends that residents continue to take precautions to minimize their exposure to arsenic in soil, as discussed in the Frequently Asked Questions section of the Soil Study Summary and Support Information, found on the following web address: http://www.metrokc.gov/health/hazard/soilsamples.htm. This document can also be obtained by telephoning Public Health at (206) 296-4692.

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APPENDIX A: Sources of Data

Rates of incidence (new cases) and mortality (deaths) are included.

Cancer Incidence: The cancer reporting rules (WAC Chapter 246-430) define reportable cancers to include "any malignant neoplasm, with the exception of basal and squamous cell carcinoma of the skin," so the Washington State Cancer Registry (WSCR) does not include non-melanoma skin cancers, unless they are located on the external genital organs. However, we were able to obtain patient information, such as age and sex, and medical information, such as type of cancer and date of diagnosis, for all other newly diagnosed cancers included in this study.

Cancer cases are identified through reports from hospitals, pathology laboratories, radiation oncology centers, ambulatory surgical centers, cancer treatment centers, and physicians. Once the case is identified, an abstract of cancer information is completed within 6 months and quality assurance activities are carried out by the contractors and reporting facilities. Data exchange agreements with Idaho and Oregon allow WSCR to obtain information on Washington residents diagnosed in those states. Based on estimates of the expected number of cancer cases, the registry includes more than 95% of newly diagnosed cancer cases. The WSCR was established in 1992, and 1998 is the most recent year of available data.

The state Department of Health provided computer files for this analysis. The analysis was carried out by Public Health.

Cancer Mortality: Cancer mortality data come from the state vital statistics collection system. Death certificates are filed with local registrars and state Center for Health Statistics (CHS). Death certificates must be filed for all deaths occurring in the state, and all other states have similar regulations. Death certificates are designed to gather information that meets federal reporting requirements of the National Center for Health Statistics. Information provided on the death certificate and used in this analysis includes name, address, age, race, date of death and underlying cause of death.

RCW Chapter 70.58, which governs the registration and reporting of vital statistics, requires prompt filing of death certificates. A formal interstate exchange agreement governs the mutual exchange of information on births and deaths between states and other countries so events occurring for Washington residents elsewhere are also reported to this state.

Population: Population figures used to calculate rates are from the Washington State Adjusted Population Estimates calculated by the state Department of Social and Health Services (DSHS). These in turn are based on county-level figures from the Office of Financial Management, the agency mandated by law to provide population estimates and projections for so-called *intercensal* and *postcensal* years—years in which the Census is not carried out. The DSHS estimates are available by age, race and sex at the census tract level. Although we believe these are the best figures available, it is important to remember that these are estimates, not counts. There is an unknown amount of error

associated with the estimates, and users are strongly urged to aggregate into larger areas whenever possible.

Neither the mortality nor incidence files contain information on length of time in residence or other environmental exposures. This is a limitation to keep in mind when interpreting the results of the analyses.

Limited information on smoking is included on the death certificate. A question, worded as "Smoking in the last 15 years (Yes/No)," has been on the death certificate since 1988. The information is collected by the funeral director (presumably from friends and family of the decedent), not the certifying physician. Studies verifying the data entered in this field have not been carried out, and its accuracy is unknown. From 1990 to 1998, information in this field for Washington State was missing 3.6% of the time. The cancer incidence files do not have information on smoking status. We examined the death certificate smoking variable as a follow-up to a finding on lung cancer (see Results section below).

Differences in Availability of Cancer Incidence and Cancer Mortality Data: See Table for the cancer types included from the mortality and incidence datasets. Cause of death information (on the death certificate) and cancer diagnosis (from the cancer registry) have different coding systems. The coding system for deaths is the International Classification of Diseases, 9th Revision (or, simply, ICD-9). The coding for cancer incidence is ICD-O (for Oncology). Unlike the ICD-O, the ICD-9 generally does not provide different codes for different types of cancer in one part of the body. For instance, ICD-O codes (cancer incidence data) can separate angiosarcoma, the only type of liver cancer associated with arsenic exposure, from other types of liver cancer, but ICD-9 codes (deaths data) cannot differentiate the different types of liver cancer. As a result, we were able to narrow the analysis to angiosarcoma when looking at cancer incidence, although we included all deaths arising from cancer of the liver for the deaths analysis.[1]

Table A-1. Cancer Types Available from Mortality and Incidence Datasets

Type	Mortality (1980-1998)	Incidence (1992-1998)
Lung	Available	Available
Bladder	Available	Available
Prostate	Available	Available
Kidney	Available	Available
Liver	All Liver Cancer	Angiosarcoma only
Skin*	Available	Not Available

*Non-melanoma skin cancer is rarely listed as a cause of death. Only one such death occurred on Vashon-Maury Island in the study period.

[1] Less than 1% of liver cancer cases are from angiosarcoma, so we believe a majority of the deaths coded as liver cancer were not angiosarcoma. As a result, we repeated the analysis of deaths data without liver cancer deaths; there was no difference, so we present only the analysis that includes liver cancer deaths. The tables showing the deaths analysis without liver cancer included are available on request.

Non-melanoma skin cancer is, however, not collected by the cancer registry, but is listed as a cause of death, although it is listed as a cause of death very infrequently. Only one such death occurred in Vashon-Maury Island from 1980-1998, and it is included in the analysis.

The ICD-9 and ICD-O codes used to define the cancer types are shown in Table A-2 below.

Table A-2. ICD* Definitions of Cancer Sites Included in Analysis

		Incidence (ICD-0)	
Cancer Site	*Mortality (ICD-9)*	*Site Code*	*Morphology Code*
Lung	162.2-162.9	C34.0-C34.9	excluding 9590-9970
Urinary Bladder	188	C67.0-C67.9	excluding 9590-9970
Prostate	185	C61.9	excluding 9590-9970
Kidney	189.0, 189.1	C64.9, C65.9	excluding 9590-9970
Liver/angiosarcoma^	155.0, 155.2	C22.0-C22.9	including 9120
Skin	173	N/A	N/A

*ICD is International Classification of Diseases.

^Liver cancer is restricted to angiosarcoma for cancer incidence, and includes all liver cancer for mortality.

APPENDIX B: Geocoding

Geocoding is the process of assigning a health event to a geopolitical subdivision for which valid population estimates exist. Geocode assignments are based on reported residential street address, city, state, and ZIP code. For this analysis, events were assigned to census tracts (for events occurring in Vashon-Maury Island residents) or County (for events occurring in residents of Washington State counties).

The process of assigning geocodes manually—by looking up a reported street address on a detailed map—is highly resource-intensive and vulnerable to error. Geocoding has become higher quality in recent years with the availability of automated geocoding software programs. The automated programs usually assign high-quality geocodes to about 90% of addresses. Whenever appropriate street address data were available, Vashon-Maury Island addresses for newly diagnosed cases of cancer and cancer deaths were first run through an automated computer program to assign them to census tracts. Addresses that couldn't be assigned high-quality geocodes using the automated process—so-called "exceptions"—were manually geocoded by a trained coder.

Cancer incidence: The residential address reported at the time of diagnosis was used to identify cases on Vashon or Maury Islands. Addresses were examined closely so that no Vashon-Maury Island cases would be missed. Records were included if they identified Vashon, Burton, or Dockton as the city, or if they listed 98013 or 98070 as the ZIP code. The ZIP code 98070 comprises both islands commonly known as Vashon Island. 98013 is the ZIP code for P.O. Boxes in Burton on Vashon Island.

Vashon-Maury Island addresses were geocoded in order to place them in the correct census tract and census block group. Geocoding makes it possible to compare cancer rates for smaller regions within the island. Out of 130 total cases of the selected cancer types diagnosed on Vashon-Maury Island from 1992-1998, 12 could not be assigned to a specific census tract or block group because of insufficient address information. For example, street addresses with only a P.O. Box can not be geocoded. These 12 cases will be included in the cancer incidence rates for the entire island, but will not be included when comparing cancer incidence between different regions of the island.

Cancer deaths: Mortality data have been geocoded (i.e., assigned to a census tract based on resident street address at time of death) since 1980 (see Geocoding section below for a detailed description). Deaths were assigned to Vashon-Maury Island if (1) they had been assigned a census tract of 277.01 or 277.02, (2) they had a reported ZIP code of 98070, 98013 or 98018 (a ZIP code that existed prior to 1990), or (3) a reported city of Vashon, Dockton or Burton.

The quality and accuracy of census-tract-level geocodes for Vashon-Maury Island deaths has varied over time. Before 1990, valid geocodes were not always assigned because (1) geocoding programs were not available so all were assigned manually, and (2) all reported Island addresses were rural routes or Post Office boxes, which are impossible to geocode with currently available maps. As a result, although events that occurred

between 1980 and 1989 on Vashon-Maury Island could be included in the analyses comparing the Island to other counties and Washington State, these events could not be included in the analysis of South Vashon-Maury and North Vashon, since we didn't know where on the island the decedents lived.

APPENDIX C: Health Effects of Ingestion of Inorganic Arsenic

This report is concerned with health data related to exposure to arsenic. Most studies of health effects related to environmental arsenic concerned populations exposed to high levels of arsenic in drinking water. In general, the exposures described in the studies of ingestion of arsenic in drinking water are much higher than those stemming from ingestion of arsenic in soils on Vashon-Maury Island, at least in part because drinking water is ingested in greater quantities than soil.

The following describes some of the historical epidemiological studies of the effects of arsenic.

Early studies noted skin and internal cancers in patients after medicinal treatment with potassium arsenite (Fowler's solution) for a variety of conditions. Studies have been conducted among residents of Taiwan, Chile, Argentina, Mexico and Utah in areas where the drinking water was contaminated with high levels of inorganic arsenic. Studies have also been conducted among smelter workers, sheep-dip factory workers, pesticide manufacturing workers, and wine vintners, all occupations in which workers are chronically exposed to arsenic.[9] The health effects that have been documented include the following:

- Excess pigmentation and keratoses of the skin of the trunk, the palms of the hands, and the soles of the feet – areas not exposed to the sun. These are called "arsenical keratoses," and are the earliest manifestation of chronic exposure to arsenic.
- Basal and squamous cell carcinomas of the skin (non-melanoma skin cancer), which arise in areas of arsenical keratoses. Unlike typical skin cancers, that tend to be single, arsenical skin cancers tend to arise in multiple anatomical sites.
- Among groups who are exposed to arsenic through their occupation, elevated rates of death from lung cancer have been noted. The workers who were exposed to arsenic the longest had higher rates of lung cancer. This relationship persisted when the effects of smoking were considered.[10]
- Liver enlargement and cancer of the liver (angiosarcoma)
- Studies of populations exposed to arsenic in drinking water showed a correlation between the arsenic level of the well water and the rates of death from lung, kidney and bladder cancer, with higher rates among those exposed to higher levels of arsenic.[11]
- A recent study among a Mormon population in Utah showed elevated rates of death from prostate cancer among men who drank arsenic-contaminated water.[12]
- Non-cancer effects of chronic arsenic ingestion, other than the arsenical keratoses described above, include peripheral vascular disease (hardening of the arteries in the hands and feet), which – in Taiwan - sometimes resulted in "Blackfoot Disease," or gangrene of the affected extremity. Studies have also shown associations of chronic arsenic exposure with effects such as peripheral neuropathy (injury to nerves which results in loss of sensation or motor function), hypertensive heart disease, and diabetes.

APPENDIX D: Results (Detailed Description)

Cancer Incidence

Selected types on Vashon-Maury Island (Table D-2): There were 130 cases of prostate, lung, bladder and kidney cancer diagnosed in VMI residents between the years 1992 and 1998. The majority were prostate cancer (n=66, 51%). The second most common type was lung cancer, which accounted for about one-third of cases (n=41, 32%). Next was bladder cancer (n=20, 15%). Three cases of kidney cancer were diagnosed during this period. The age-adjusted incidence rate for the types combined was 190.4.

Selected types combined compared to Washington State and counties (Table D-3): The VMI rate (190.4 per 100,000) was slightly higher than the rate for Washington State (183.1) and King County (172.4). The difference was not statistically significant. There were no statistically significant differences between VMI and the state or other county rates.

Lung and bladder cancer combined (Table D-4): There were 61 cases diagnosed in VMI residents, for a rate of 89.7 per 100,000. This rate was virtually the same as the rate for King County (88.8) and slightly lower than the Washington State rate (94.5). The VMI rate was significantly lower than the rate for Grays Harbor (130.8) and Mason (239.5 per 100,l000) Counties.

Lung cancer (Table D-5): There were 41 VMI cases, for a rate of 60.3 per 100,000. This was moderately lower than the rate for King County (67.1 per 100,000) and Washington State (71.5 per 100,000); these differences were not statistically significant. The VMI rate was significantly lower than the rate for Grays Harbor (103.2 per 100,000) and Mason County (102.2 per 100,000).

Bladder cancer (Table D-6): There were 20 cases diagnosed to VMI residents, for a rate of 29.4 per 100,000. This was moderately higher than the rate for King County (21.7 per 100,000) and Washington State (23.0 per 100,000); these differences were not statistically significant. There were no statistically significant differences between VMI and the state or other county rates.

Prostate cancer (Table D-7): Sixty-six VMI cases were diagnosed, for a rate of 211.5 per 100,000. This was moderately higher than the King County rate (168.9 per 100,000 per 100,000) and the State total (176.3 per 100,000), although the differences were not statistically significant. There were no statistically significant differences between VMI and the state or other county rates.

Kidney cancer (Table D-8): Three cases of kidney cancer were reported on VMI, for a rate of 4.7 per 100,000. Based on very small numbers, the rate was moderately lower than the rate for King County (11.0) and Washington State (11.5). There were no statistically significant differences between VMI and the state or other county rates.

Liver cancer (Table D-9): No cases of liver cancer were reported for VMI, and no statistical comparisons were carried out. Only one case occurred in King County, out of a total of three in Washington State.

Comparison of South Vashon-Maury Island to North Vashon Island (Table D-10): The rate seen in residents of South Vashon-Maury Island for all types combined (177.1 per 100,000) was slightly higher than the rate is North Vashon (169.4 per 100,000). This was not a statistically significant difference.

Cancer Mortality

Selected types on Vashon-Maury Island, 1980-1998 (Table D-11): There were 137 deaths from lung, prostate, bladder, liver, kidney and skin cancer between 1980 and 1998. Almost three in four were lung cancer (n=97, 71%), indicating that lung cancer mortality will heavily influence the patterns seen in all types combined. Prostate cancer deaths was the next largest category (n=26, 19% of deaths). The remaining categories taken together accounted for less than one death per year, on average.

Selected types combined compared to Washington State and counties, 1980-1998 (Table D-12): The VMI rate (84.3 per 100,000) was virtually the same as the rate for Washington State (82.5) and slightly higher than the rate for King County (78.6). These were not statistically significant differences. The VMI rates were significantly higher than the rate for San Juan County (57.6), which had the lowest rate in the state and was also significantly lower than 32 of Washington's counties, including King County.

All types combined, 1990-1998 (Table D-13) and 1980-1989 (Table D-14): There were no statistically significant differences between VMI and the state or county rates. When ranked with the other counties, VMI dropped from 8th highest in 1980-1989 to 31st from 1990-1998, but the difference in rates on VMI for the two time periods is not statistically significant, and a test for trend over time was not statistically significant (not shown).

The analyses below all cover cancer mortality for the entire 1980-1998 period, except where noted.

Lung and bladder combined (Table D-15): There were 103 deaths from lung and bladder cancer, for a rate of 60.6 per 100,000. This was similar to the rate for Washington State (61.8 per 100,000) and King County (58.3 per 100,000). The VMI rate was significantly higher than the rate for San Juan County (39.9 per 100,000).

Lung cancer (Table D-16): Lung cancer accounted for 95% (97 of 103) of the lung and bladder cancer combined deaths, so very similar patterns were seen for lung cancer alone. The VMI rate (56.8 per 100,000) was similar to the rate for Washington State (57.2) and King County (53.8). The VMI rate was significantly higher than the rate for San Juan County (34.7).

Bladder cancer (Table D-17): There were six bladder cancer deaths on VMI, for a rate of 3.8 per 100,000. This was moderately lower than the rate for King County (4.6) and

Washington State (4.6). There were no statistically significant differences between VMI and the state or county rates.

Prostate cancer (Table D-18): There were 26 deaths from prostate cancer on VMI, for a rate of 49.4 per 100,000. The VMI rate ranked highest in the state compared to Washington State (35.0), King County (35.8) and all other counties, although the differences were not statistically significant.

Kidney cancer (Table D-19): Three kidney cancer deaths were reported for VMI, for a rate of 2.0 per 100,000. Based on a very small number of deaths, the rate was moderately lower than the rate for King County (3.7) and Washington State (4.0). There were no statistically significant differences between VMI and the state or other county rates.

Liver cancer (Table D-20): Four liver cancer deaths were reported for VMI, for a rate of 2.7 per 100,000. There were no statistically significant differences between VMI and the state or other county rates.

Non-melanoma skin cancer (Table D-21): One death occurred on VMI. There were no statistically significant differences between VMI and the state or other county rates.

Comparison of South Vashon-Maury Island to North Vashon Island, 1990-1998 (Table D-22): For all types combined, the rate on North Vashon Island (97.2 per 100,000) was almost twice the rate for South Vashon-Maury Island (51.1 per 100,000). This was not a statistically significant difference. For a discussion of this difference and **Table D-25**, see Section III. Results (Summary) and Section **Error! Reference source not found.**, above.

Table D-1

Summary of Comparisons* for Selected Cancer Types¶
Vashon Island, Washington State, King County and other Counties

		Vashon compared to WA State	Vashon compared to King County	Vashon signicantly higher than Counties:	Vashon significantly lower than Counties:	North Vashon compared to South Vashon-Maury:	Number of Vashon Island Cases or Deaths:
Types combined	Incidence	NS	NS	None	None	NS	130
	Mortality (1980-1998)	NS	NS	**San Juan**	None	NS	137
	Mortality (1990-1998)	NS	NS	None	None	NS	68
	Mortality (1980-1989)	NS	NS	None	None	NS	69
Lung and bladder	Incidence	NS	NS	None	**Grays Harbor, Mason**	NS	61
	Mortality	NS	NS	**San Juan**	None	NS	103
Lung	Incidence	NS	NS	None	**Grays Harbor, Mason**	NS	41
	Mortality	NS	NS	**San Juan**	None	NS	97
Bladder	Incidence	NS	NS	None	None	NS	20
	Mortality	NS	NS	None	None	NS	6
Prostate	Incidence	NS	NS	None	None	NS	66
	Mortality	NS	NS	None	None	NS	26
Kidney	Incidence	NS	NS	None	None	NS	3
	Mortality	NS	NS	None	None	NS	3
Liver^	Incidence	~	~	~	~	~	0
	Mortality	NS	NS	None	None	NS	4
Skin	Incidence	N/A	N/A	N/A	N/A	N/A	N/A
	Mortality	NS	NS	None	None	~†	1

*For all analyses execpt the North-South VMI comparison, the ime period is 1980-1998 for mortality and 1992-1998 for incidence analyses, except where noted.
For the North-South VMI comparison, mortality data as available from 1990-1998 only.

¶Selected cancer types include lung, bladder, prostate, kidney, liver and skin cancer.

^Liver cancer is restricted to angiosarcoma for cancer incidence, and includes all liver cancer for mortality.

~ indicates that no comparison was calculated since there were 0 cases or deaths on Vashon-Maury Island.

† The one skin cancer death on VMI occurred prior to 1990 and is not included in the North-South comparison.

N/A is data not available, because non-melanoma skin cancer is not reported to cancer registry.

NS is not statistically significant.

Table D-2

Number of Cases and Age-adjusted Cancer Incidence Rate*
Selected Types, Vashon-Maury Island, 1992-1998 Average

			*95% CL^*			
TYPE	RATE*	PER	LOWER	UPPER	NUMBER OF CASES	PERCENT OF TOTAL
Lung	60.3	100,000	43.2	83.3	41	31.5%
Bladder	29.4	100,000	17.9	47.1	20	15.4%
Prostate	211.5	100,000	162.3	275.4	66	50.8%
Kidney	4.7	100,000	0.9	15.9	3	2.3%
Liver	0.0	100,000	~	~	0	0.0%
Lung & Bladder	89.7	100,000	68.5	116.7	61	46.9%
All Selected Types	190.4	100,000	158.9	227.4	130	100.0%

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
~ indicates that no confidence interval was calculated since there were 0 cases.

Data Sources:
Cancer Incidence Data: Washington State Cancer Registry
Population Estimates:
Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999
Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-3

Number of Cases and Age-adjusted Cancer Incidence Rate*, Selected Cancer Types, Washington State, Counties and Vashon-Maury Island, 1992-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Mason	233.5	100,000	218.1	249.8	879
Grays Harbor	229.9	100,000	217.1	243.3	1227
Jefferson	223.8	100,000	205.1	244.1	554
Okanogan	210.3	100,000	193.2	228.6	559
Stevens	210.1	100,000	191.9	229.5	493
Columbia	208.8	100,000	165.2	262.9	81
Chelan	208.4	100,000	195.2	222.4	934
Skamania	205.5	100,000	170.1	246.8	120
Ferry	201.9	100,000	160.8	251.8	86
Franklin	200.0	100,000	181.8	219.8	448
Lincoln	200.0	100,000	172.0	232.2	186
Asotin	197.9	100,000	175.9	222.1	300
Lewis	197.1	100,000	184.9	209.9	988
Walla Walla	194.4	100,000	180.8	208.8	775
Grant	192.2	100,000	179.3	205.9	832
Kittitas	191.5	100,000	172.3	212.3	366
VASHON ISLAND	190.4	100,000	158.9	227.4	130
Spokane	189.6	100,000	184.4	194.9	5053
Kitsap	188.8	100,000	181.3	196.6	2380
Whatcom	188.6	100,000	180.0	197.6	1789
Cowlitz	187.6	100,000	177.1	198.5	1212
Pierce	186.1	100,000	181.8	190.5	7198
Pend Oreille	186.0	100,000	157.7	218.5	155
Benton	185.8	100,000	176.0	196.1	1354
Clark	185.1	100,000	178.7	191.7	3152
Skagit	183.8	100,000	174.0	194.0	1339
Thurston	183.5	100,000	175.9	191.3	2221
State Total	183.1	100,000	181.6	184.5	63055
Pacific	183.1	100,000	165.3	202.8	410
Snohomish	181.9	100,000	177.0	186.8	5383
Douglas	177.2	100,000	159.7	196.2	379
Clallam	173.9	100,000	163.8	184.7	1150
King	172.4	100,000	169.8	175.0	16945
Garfield	171.3	100,000	124.2	236.7	44
Adams	170.4	100,000	144.2	200.2	151
Yakima	169.5	100,000	162.6	176.6	2270
Island	169.0	100,000	157.7	181.0	868
Whitman	163.6	100,000	145.9	182.9	311
Klickitat	161.1	100,000	140.1	184.5	212
Wahkiakum	154.4	100,000	115.4	204.5	53
San Juan	136.6	100,000	116.4	160.8	168

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher
Selected cancer types include lung, bladder, kidney and prostate cancer (see text for details)

Data Sources:
Cancer Incidence Data: Washington State Cancer Registry
Population Estimates:
Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999
Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-4

Number of Cases and Age-adjusted Cancer Incidence Rate*, Lung and Bladder Cancer Combined, Washington State, Counties and Vashon-Maury Island, 1992-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Grays Harbor†	130.8	100,000	121.2	141.0	694
Mason†	129.5	100,000	118.1	141.8	485
Okanogan	111.6	100,000	99.2	125.1	296
Jefferson	108.8	100,000	95.8	123.5	265
Kitsap	104.9	100,000	99.3	110.8	1323
Pacific	102.6	100,000	89.2	117.9	225
Cowlitz	102.3	100,000	94.6	110.4	660
Stevens	102.2	100,000	89.7	116.1	239
Ferry	100.3	100,000	72.1	137.4	43
Lewis	99.8	100,000	91.2	109.1	498
Thurston	98.8	100,000	93.3	104.6	1193
Clark	98.5	100,000	93.9	103.4	1674
Pierce	98.0	100,000	94.9	101.2	3796
Skagit	97.3	100,000	90.2	104.8	704
Chelan	96.8	100,000	87.8	106.5	431
Asotin	96.7	100,000	81.4	114.2	145
Snohomish	96.3	100,000	92.7	99.9	2846
Kittitas	96.1	100,000	82.7	111.2	184
Spokane	95.9	100,000	92.2	99.7	2562
Franklin	95.0	100,000	82.6	109.0	212
State Total	94.5	100,000	93.4	95.5	32508
Clallam	94.2	100,000	86.7	102.4	610
Skamania	92.8	100,000	69.5	122.2	54
Pend Oreille	92.3	100,000	72.6	116.2	76
Benton	90.5	100,000	83.7	97.8	657
Garfield	90.4	100,000	57.1	143.0	23
Yakima	90.4	100,000	85.4	95.7	1210
VASHON ISLAND	89.7	100,000	68.5	116.7	61
King	88.8	100,000	87.0	90.7	8735
Grant	87.4	100,000	78.7	96.9	376
Island	86.5	100,000	78.4	95.2	439
Whatcom	85.9	100,000	80.0	92.0	815
Walla Walla	85.3	100,000	76.3	95.1	336
Columbia	84.9	100,000	57.8	123.2	32
Klickitat	83.2	100,000	68.3	100.5	109
Lincoln	82.8	100,000	65.2	104.7	77
Wahkiakum	79.2	100,000	51.5	118.8	26
Douglas	76.3	100,000	64.9	89.2	162
Whitman	72.3	100,000	60.7	85.4	138
Adams	72.0	100,000	55.4	92.2	64
San Juan	67.9	100,000	53.8	86.1	83

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher

Data Sources:
Cancer Incidence Data: Washington State Cancer Registry
Population Estimates:
Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999
Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-5

Number of Cases and Age-adjusted Cancer Incidence Rate*, Lung Cancer, Washington State, Counties and Vashon-Maury Island, 1992-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Grays Harbor†	103.2	100,000	94.7	112.3	546
Mason†	102.2	100,000	92.0	113.2	382
Okanogan	85.2	100,000	74.5	97.1	227
Kitsap	80.5	100,000	75.6	85.6	1019
Pend Oreille	79.4	100,000	61.3	101.7	66
Columbia	79.3	100,000	53.2	116.6	30
Jefferson	78.2	100,000	67.3	90.9	191
Asotin	77.7	100,000	64.0	93.6	116
Ferry	76.7	100,000	52.4	110.1	33
Pierce	76.5	100,000	73.8	79.3	2970
Franklin	76.4	100,000	65.4	89.0	172
Cowlitz	76.1	100,000	69.6	83.2	493
Stevens	76.1	100,000	65.3	88.2	178
Lewis	75.1	100,000	67.6	83.2	375
Pacific	75.0	100,000	63.7	88.2	167
Chelan	74.6	100,000	66.7	83.2	332
Snohomish	74.4	100,000	71.3	77.6	2201
Clark	74.0	100,000	70.0	78.2	1261
Thurston	73.3	100,000	68.6	78.3	887
Skagit	72.5	100,000	66.4	79.1	524
Spokane	72.4	100,000	69.2	75.7	1932
State Total	71.5	100,000	70.6	72.4	24636
Benton	70.8	100,000	64.7	77.3	514
Garfield	69.9	100,000	41.2	118.1	18
King	67.1	100,000	65.5	68.8	6606
Kittitas	66.6	100,000	55.5	79.3	127
Skamania	66.5	100,000	47.1	92.0	39
Klickitat	66.4	100,000	53.2	82.1	87
Yakima	66.2	100,000	61.9	70.8	884
Clallam	65.7	100,000	59.5	72.6	423
Island	64.0	100,000	57.0	71.6	322
Walla Walla	63.6	100,000	55.8	72.1	250
Grant	62.4	100,000	55.1	70.5	270
Whatcom	62.2	100,000	57.3	67.5	591
Lincoln	62.1	100,000	46.9	81.7	57
VASHON ISLAND	60.3	100,000	43.2	83.3	41
Adams	54.7	100,000	40.5	72.7	49
Douglas	54.5	100,000	45.0	65.6	116
Whitman	51.9	100,000	42.1	63.2	99
Wahkiakum	50.1	100,000	28.5	84.1	16
San Juan	44.9	100,000	33.6	60.4	55

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher

Data Sources:
Cancer Incidence Data: Washington State Cancer Registry
Population Estimates:
Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999
Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-6

Number of Cases and Age-adjusted Cancer Incidence Rate*, Bladder Cancer, Washington State, Counties and Vashon-Maury Island, 1992-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Jefferson	30.5	100,000	23.8	39.0	74
Kittitas	29.6	100,000	22.4	38.4	57
VASHON ISLAND	29.4	100,000	17.9	47.1	20
Wahkiakum	29.1	100,000	13.9	56.7	10
Clallam	28.5	100,000	24.5	33.2	187
Grays Harbor	27.6	100,000	23.3	32.5	148
Pacific	27.6	100,000	20.7	36.6	58
Mason	27.3	100,000	22.2	33.3	103
Okanogan	26.4	100,000	20.5	33.5	69
Skamania	26.4	100,000	14.7	44.6	15
Cowlitz	26.1	100,000	22.3	30.4	167
Stevens	26.1	100,000	20.0	33.7	61
Thurston	25.5	100,000	22.7	28.5	306
Grant	25.0	100,000	20.5	30.4	106
Lewis	24.7	100,000	20.5	29.6	123
Skagit	24.7	100,000	21.2	28.7	180
Clark	24.5	100,000	22.2	27.1	413
Kitsap	24.4	100,000	21.7	27.3	304
Yakima	24.2	100,000	21.6	27.0	326
Ferry	23.6	100,000	11.1	46.0	10
Whatcom	23.6	100,000	20.6	26.9	224
Spokane	23.5	100,000	21.7	25.4	630
State Total	23.0	100,000	22.5	23.5	7872
San Juan	23.0	100,000	15.1	35.4	28
Island	22.5	100,000	18.5	27.2	117
Chelan	22.2	100,000	18.0	27.2	99
Snohomish	21.9	100,000	20.2	23.7	645
Douglas	21.8	100,000	15.9	29.3	46
King	21.7	100,000	20.8	22.7	2129
Walla Walla	21.7	100,000	17.3	27.0	86
Pierce	21.5	100,000	20.1	23.0	826
Lincoln	20.7	100,000	12.6	33.5	20
Garfield	20.5	100,000	6.6	57.4	5
Whitman	20.4	100,000	14.5	28.0	39
Benton	19.8	100,000	16.6	23.4	143
Asotin	19.0	100,000	12.7	27.7	29
Franklin	18.6	100,000	13.2	25.6	40
Adams	17.2	100,000	9.6	28.7	15
Klickitat	16.7	100,000	10.5	25.6	22
Pend Oreille	12.9	100,000	6.1	24.3	10
Columbia	5.6	100,000	0.7	25.2	2

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher

Data Sources:
Cancer Incidence Data: Washington State Cancer Registry
Population Estimates:
Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999
Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-7

Number of Cases and Age-adjusted Cancer Incidence Rate*, Prostate Cancer, Washington State, Counties and Vashon-Maury Island, 1992-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Columbia	235.7	100,000	170.4	321.7	44
Lincoln	233.9	100,000	189.5	287.4	98
Chelan	232.5	100,000	211.5	255.2	453
Walla Walla	226.4	100,000	204.7	250.0	399
Jefferson	218.4	100,000	191.8	248.6	258
Asotin	217.3	100,000	183.1	256.3	145
Stevens	214.4	100,000	187.7	244.3	238
VASHON ISLAND	211.5	100,000	162.3	275.4	66
Douglas	207.9	100,000	179.6	240.4	204
Skamania	204.6	100,000	154.0	270.2	57
Franklin	203.9	100,000	176.2	235.7	207
Grant	201.9	100,000	182.5	223.3	408
Whatcom	198.5	100,000	185.2	212.7	842
Adams	194.3	100,000	153.1	245.1	79
Okanogan	192.1	100,000	168.0	219.1	232
Ferry	191.8	100,000	133.9	271.5	39
Spokane	191.3	100,000	183.3	199.6	2184
Lewis	189.1	100,000	171.6	208.2	431
Mason	188.7	100,000	168.7	211.1	337
Grays Harbor	187.5	100,000	170.6	205.9	460
Benton	183.9	100,000	168.9	200.1	592
Kittitas	179.1	100,000	151.8	210.5	154
Whitman	178.5	100,000	151.6	209.1	158
State Total	176.3	100,000	174.1	178.5	26567
Pierce	175.2	100,000	168.8	181.9	2908
Thurston	171.3	100,000	160.0	183.2	900
Clark	171.1	100,000	161.6	181.1	1277
Snohomish	170.9	100,000	163.6	178.5	2192
King	168.9	100,000	165.0	173.0	7099
Cowlitz	167.6	100,000	152.8	183.6	481
Skagit	166.6	100,000	152.8	181.5	550
Pend Oreille	165.0	100,000	126.3	213.7	65
Kitsap	164.4	100,000	153.7	175.8	911
Yakima	159.4	100,000	149.3	170.0	938
Garfield	159.1	100,000	95.5	262.3	19
Island	156.0	100,000	140.3	173.6	377
Wahkiakum	153.6	100,000	99.1	232.4	25
Pacific	152.5	100,000	129.5	179.5	163
Clallam	149.1	100,000	135.6	163.9	463
Klickitat	139.5	100,000	111.6	173.4	87
San Juan	127.8	100,000	99.5	164.6	77

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher

Data Sources:
Cancer Incidence Data: Washington State Cancer Registry
Population Estimates:
Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999
Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-8

Number of Cases and Age-adjusted Cancer Incidence Rate*, Kidney Cancer, Washington State, Counties and Vashon-Maury Island, 1992-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Pend Oreille	17.1	100,000	9.3	29.4	14
Mason	16.2	100,000	12.2	21.1	57
Skamania	15.3	100,000	6.9	30.5	9
Kittitas	14.8	100,000	9.8	21.5	28
Benton	14.0	100,000	11.4	17.0	105
Grays Harbor	14.0	100,000	11.0	17.8	73
Whatcom	14.0	100,000	11.7	16.6	132
Jefferson	13.8	100,000	9.3	20.3	31
Franklin	12.8	100,000	8.5	18.7	29
Lewis	12.6	100,000	9.5	16.3	59
Pierce	12.6	100,000	11.5	13.8	494
Klickitat	12.4	100,000	7.1	20.4	16
Clallam	12.3	100,000	9.6	15.7	77
Lincoln	11.9	100,000	5.9	22.9	11
Skagit	11.9	100,000	9.5	14.8	85
Chelan	11.8	100,000	8.7	15.6	50
Spokane	11.8	100,000	10.5	13.2	307
State Total	11.5	100,000	11.1	11.8	3977
Clark	11.5	100,000	9.9	13.2	201
Grant	11.5	100,000	8.5	15.4	48
Okanogan	11.5	100,000	7.8	16.6	30
Kitsap	11.3	100,000	9.5	13.3	146
Cowlitz	11.2	100,000	8.7	14.2	71
Island	11.0	100,000	8.2	14.6	52
King	11.0	100,000	10.3	11.6	1110
Snohomish	11.0	100,000	9.9	12.3	345
Columbia	10.8	100,000	2.9	32.3	4
Pacific	10.8	100,000	6.6	17.4	22
Thurston	10.4	100,000	8.6	12.4	128
Walla Walla	10.3	100,000	7.3	14.1	40
Ferry	9.5	100,000	2.6	27.2	4
Yakima	9.3	100,000	7.8	11.2	122
Adams	9.0	100,000	3.9	18.2	8
Whitman	8.0	100,000	4.5	13.3	15
Garfield	7.5	100,000	0.9	39.6	2
San Juan	7.4	100,000	3.1	17.0	8
Asotin	7.0	100,000	3.3	13.2	10
Stevens	6.8	100,000	3.9	11.2	16
Douglas	6.3	100,000	3.3	11.0	13
Wahkiakum	5.5	100,000	0.7	24.8	2
VASHON ISLAND	4.7	100,000	0.9	15.9	3

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher

Data Sources:
Cancer Incidence Data: Washington State Cancer Registry
Population Estimates:
Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999
Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-9

Number of Cases and Age-adjusted Cancer Incidence Rate*, Liver Cancer, Washington State, Counties and Vashon-Maury Island, 1992-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Columbia	2.3	100,000	0.1	20.0	1
Okanogan	0.4	100,000	0.0	2.3	1
State Total	0.0	100,000	0.0	0.0	3
King	0.0	100,000	0.0	0.1	1
VASHON ISLAND	0.0	100,000	~	~	0

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher
~ indicates that no confidence interval was calculated since there were 0 cases.
Counties with 0 cases are not shown.

Data Sources:
Cancer Incidence Data: Washington State Cancer Registry
Population Estimates:
Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999
Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-10

Number of Cases and Age-adjusted Cancer Incidence Rate*
Selected Types, North Vashon Island and South Vashon-Maury Island,¶
1992-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER†
North Vashon Island	169.4	100,000	130.1	218.6	63
South Vashon-Maury Island	177.1	100,000	132.7	235.5	55

*Rates are adjusted to the 2000 U.S. Population Standard
¶North Vashon Island is Census Tract 277.01;South Vashon-Maury Island is census tract 277.02
^CL is Confidence Limit
†Twelve cases could not be assigned to a census tract beause of insufficient address information, and are not included in the totals.
Selected cancer types include lung, bladder, kidney and prostate cancer (see text for details)

Data Sources:
Cancer Incidence Data: Washington State Cancer Registry
Population Estimates:
Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999
Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-11

Number of Deaths and Age-adjusted Cancer Mortality Rate*
Selected Types, Vashon-Maury Island, 1980-1998 Average

*95% CL^*

TYPE	RATE*	PER	LOWER	UPPER	NUMBER OF DEATHS	PERCENT OF TOTAL
Lung	56.8	100,000	46.0	69.8	97	70.8%
Bladder	3.8	100,000	1.4	8.8	6	4.4%
Prostate	49.4	100,000	31.1	76.1	26	19.0%
Kidney	2.0	100,000	0.4	6.3	3	2.2%
Liver	2.7	100,000	0.7	7.4	4	2.9%
Skin	0.7	100,000	0.0	4.4	1	0.7%
Lung & Bladder	60.6	0.0	49.4	74.0	103	75.2%
All Selected Types	84.3	100,000	70.6	100.2	137	100.0%

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
Selected cancer types include lung, bladder, kidney, liver, prostate and non-melanoma skin cancer (see text for details)

Data Sources:
Cancer Mortality Data: Washington State Department of Health, Center for Health Statistics
Population Estimates:
1990-2002: Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999;
1980-1989 ZIP Code and 1980-1986 Census Tract Population Estimates are based on figures from Claritas Corporation;
1987-1989 Census Tract Population Estimates are from Department of Social and Health Services, December 1995.
Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-12

Number of Deaths and Age-adjusted Cancer Death Rate*, Selected Cancer Types, Washington State, Counties and Vashon-Maury Island, 1980-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Mason	101.7	100,000	94.8	109.1	847
Pend Oreille	100.7	100,000	86.7	116.5	189
Grays Harbor	99.4	100,000	94.1	105.0	1354
Skamania	96.5	100,000	80.0	116.0	128
Pacific	96.3	100,000	87.8	105.5	508
Klickitat	95.7	100,000	85.2	107.2	308
Lewis	92.6	100,000	87.3	98.1	1166
Garfield	91.0	100,000	68.9	119.7	60
Cowlitz	89.9	100,000	85.2	94.8	1394
Jefferson	89.4	100,000	81.3	98.3	472
Franklin	89.2	100,000	81.2	97.9	477
Clark	89.0	100,000	86.0	92.2	3299
Okanogan	88.5	100,000	81.4	96.1	584
Stevens	85.8	100,000	78.2	94.0	474
Grant	85.4	100,000	79.5	91.6	822
Chelan	85.3	100,000	80.0	90.9	964
Clallam	84.9	100,000	80.2	90.0	1237
Kitsap	84.7	100,000	81.3	88.1	2451
Pierce	84.5	100,000	82.6	86.5	7611
Benton	84.4	100,000	79.9	89.2	1367
VASHON ISLAND	84.3	100,000	70.6	100.2	137
Snohomish	83.9	100,000	81.6	86.2	5402
Island	83.2	100,000	77.6	89.2	875
Kittitas	83.1	100,000	75.2	91.8	404
Spokane	83.1	100,000	80.9	85.3	5548
Yakima	82.8	100,000	79.8	86.0	2844
State Total	82.5	100,000	81.9	83.2	67134
Thurston	82.5	100,000	79.1	86.0	2205
Asotin	80.7	100,000	71.9	90.4	312
Skagit	80.1	100,000	75.8	84.6	1321
King	78.6	100,000	77.4	79.7	18774
Ferry	78.1	100,000	61.5	98.7	78
Douglas	77.2	100,000	69.2	85.9	352
Adams	76.8	100,000	65.5	89.7	166
Columbia	76.3	100,000	60.3	95.9	80
Whatcom	73.1	100,000	69.5	76.7	1630
Lincoln	72.3	100,000	61.9	84.5	174
Walla Walla	69.7	100,000	64.7	75.1	721
Wahkiakum	67.2	100,000	51.1	87.6	59
Whitman	63.5	100,000	56.8	70.9	323
San Juan¶	57.6	100,000	48.6	68.4	154

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher
Selected cancer types include lung, bladder, kidney, liver, prostate and non-melanoma skin cancer (see text for details)

Data Sources:

Cancer Mortality Data:Washington State Department of Health, Center for Health Statistics

Population Estimates:

1990-2002: Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999;

1980-1989 ZIP Code and 1980-1986 Census Tract Population Estimates are based on figures from Claritas Corporation;

1987-1989 Census Tract Population Estimates are from Department of Social and Health Services, December 1995.

Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-13

Number of Deaths and Age-adjusted Cancer Death Rate*, Selected Cancer Types, Washington State, Counties and Vashon-Maury Island, 1990-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Grays Harbor	109.3	100,000	101.5	117.6	743
Mason	107.9	100,000	98.5	118.2	496
Garfield	107.1	100,000	73.4	155.5	34
Columbia	103.0	100,000	76.7	137.7	52
Pend Oreille	100.5	100,000	81.5	122.8	99
Skamania	99.2	100,000	76.9	126.7	69
Franklin	97.6	100,000	86.2	110.3	270
Lewis	96.7	100,000	89.2	104.7	626
Ferry	95.2	100,000	70.9	126.6	52
Okanogan	94.4	100,000	84.2	105.5	315
Cowlitz	93.6	100,000	87.1	100.6	758
Pacific	93.6	100,000	82.4	106.3	265
Stevens	92.2	100,000	81.4	104.0	266
Asotin	91.0	100,000	78.1	105.8	179
Clark	91.0	100,000	86.9	95.2	1886
Kittitas	88.7	100,000	77.3	101.4	218
Benton	88.2	100,000	82.0	94.7	776
Kitsap	88.2	100,000	83.6	93.0	1376
Klickitat	87.8	100,000	74.1	103.4	146
Spokane	86.9	100,000	83.7	90.1	2951
Pierce	86.5	100,000	83.9	89.2	4140
Jefferson	86.3	100,000	75.9	98.1	262
Thurston	86.2	100,000	81.5	91.0	1285
Adams	86.0	100,000	69.5	105.4	95
Chelan	85.9	100,000	78.4	94.0	491
Yakima	85.2	100,000	80.9	89.7	1460
State Total	84.8	100,000	83.9	85.7	36433
Snohomish	83.9	100,000	80.9	87.0	3011
Clallam	83.5	100,000	77.2	90.2	688
Grant	81.9	100,000	74.2	90.2	430
Skagit	81.6	100,000	75.8	87.8	736
King	80.6	100,000	79.0	82.2	9939
VASHON ISLAND	80.4	100,000	62.3	102.8	68
Lincoln	77.7	100,000	62.5	96.3	92
Island	77.1	100,000	70.1	84.7	471
Whatcom	76.4	100,000	71.5	81.5	912
Walla Walla	75.2	100,000	67.8	83.2	387
Wahkiakum	71.8	100,000	49.0	103.8	32
Douglas	69.1	100,000	59.2	80.3	177
Whitman	68.4	100,000	58.5	79.7	168
San Juan	53.4	100,000	42.1	68.1	80

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher
Selected cancer types include lung, bladder, kidney, liver, prostate and non-melanoma skin cancer (see text for details)

Data Sources:

Cancer Mortality Data:Washington State Department of Health, Center for Health Statistics

Population Estimates:

1990-2002: Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999;

1980-1989 ZIP Code and 1980-1986 Census Tract Population Estimates are based on figures from Claritas Corporation;

1987-1989 Census Tract Population Estimates are from Department of Social and Health Services, December 1995.

Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-14

Number of Deaths and Age-adjusted Cancer Death Rate*, Selected Cancer Types, Washington State, Counties and Vashon-Maury Island, 1980-1989 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Klickitat	105.2	100,000	89.3	123.4	162
Pend Oreille	100.5	100,000	80.4	124.6	90
Pacific	99.2	100,000	86.6	113.6	243
Skamania	94.2	100,000	70.2	125.6	59
Jefferson	93.8	100,000	80.9	108.6	210
Mason	93.6	100,000	83.6	104.7	351
Island	92.3	100,000	82.9	102.5	404
VASHON ISLAND	89.9	100,000	69.5	115.0	69
Grays Harbor	89.6	100,000	82.5	97.2	611
Grant	89.3	100,000	80.3	99.2	392
Lewis	87.8	100,000	80.4	95.8	540
Douglas	87.2	100,000	74.4	102.0	175
Clark	86.5	100,000	82.0	91.3	1413
Clallam	86.0	100,000	78.7	93.9	549
Cowlitz	85.2	100,000	78.6	92.3	636
Chelan	84.8	100,000	77.2	93.1	473
Snohomish	83.8	100,000	80.4	87.3	2391
Okanogan	82.4	100,000	72.7	93.2	269
Pierce	82.1	100,000	79.3	84.9	3471
Kitsap	80.8	100,000	75.9	85.9	1075
Yakima	80.6	100,000	76.4	85.1	1384
State Total	79.9	100,000	79.0	80.8	30701
Benton	79.4	100,000	72.9	86.5	591
Franklin	79.2	100,000	68.4	91.5	207
Spokane	79.2	100,000	76.2	82.4	2597
Skagit	77.9	100,000	71.5	84.7	585
Thurston	77.9	100,000	72.9	83.2	920
Stevens	77.8	100,000	67.4	89.4	208
Kittitas	77.0	100,000	66.2	89.4	186
King	76.5	100,000	74.9	78.1	8835
Garfield	76.4	100,000	49.2	117.0	26
Asotin	70.3	100,000	58.7	83.9	133
Whatcom	69.3	100,000	64.3	74.7	718
Lincoln	67.8	100,000	53.6	85.3	82
Adams	66.2	100,000	51.4	84.1	71
Walla Walla	64.3	100,000	57.5	71.9	334
San Juan	63.4	100,000	49.1	81.8	74
Wahkiakum	61.9	100,000	40.5	92.9	27
Ferry	60.1	100,000	38.6	91.0	26
Whitman	59.9	100,000	50.8	70.4	155
Columbia	52.5	100,000	34.4	78.5	28

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher
Selected cancer types include lung, bladder, kidney, liver, prostate and non-melanoma skin cancer (see text for details)

Data Sources:

Cancer Mortality Data:Washington State Department of Health, Center for Health Statistics

Population Estimates:

1990-2002: Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999;

1980-1989 ZIP Code and 1980-1986 Census Tract Population Estimates are based on figures from Claritas Corporation;

1987-1989 Census Tract Population Estimates are from Department of Social and Health Services, December 1995.

Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-15

Number of Deaths and Age-adjusted Cancer Death Rate*, Lung and Bladder Cancer Combined, Washington State, Counties and Vashon-Maury Island, 1980-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Mason	79.2	100,000	73.1	85.7	665
Pacific	77.4	100,000	69.9	85.7	411
Grays Harbor	76.9	100,000	72.3	81.8	1050
Pend Oreille	76.9	100,000	64.8	90.7	148
Klickitat	70.0	100,000	61.1	79.8	228
Clark	68.5	100,000	65.9	71.3	2576
Lewis	68.5	100,000	64.0	73.3	865
Skamania	68.5	100,000	54.9	85.0	93
Cowlitz	67.5	100,000	63.5	71.7	1055
Jefferson	66.8	100,000	59.9	74.5	360
Okanogan	66.4	100,000	60.3	73.0	440
Franklin	65.4	100,000	58.7	72.8	358
Garfield	65.4	100,000	46.6	91.0	42
Kitsap	64.9	100,000	62.0	67.9	1897
Clallam	64.8	100,000	60.6	69.2	943
Pierce	64.3	100,000	62.6	66.0	5861
Chelan	63.9	100,000	59.3	68.8	723
Yakima	63.2	100,000	60.5	65.9	2175
Island	63.0	100,000	58.1	68.2	675
Spokane	62.9	100,000	61.0	64.8	4205
Snohomish	62.3	100,000	60.3	64.2	4089
Thurston	62.2	100,000	59.3	65.3	1678
Benton	62.1	100,000	58.3	66.2	1030
State Total	61.8	100,000	61.3	62.4	50787
Grant	61.7	100,000	56.8	66.9	609
Asotin	61.5	100,000	53.8	70.2	235
Stevens	61.2	100,000	54.8	68.1	343
Ferry	61.0	100,000	46.7	79.3	63
VASHON ISLAND	60.6	100,000	49.4	74.0	103
Skagit	60.1	100,000	56.4	64.0	995
Kittitas	59.4	100,000	52.7	66.8	289
King	58.3	100,000	57.4	59.3	14071
Douglas	56.4	100,000	49.6	63.9	260
Adams	56.1	100,000	46.6	67.2	123
Columbia	53.5	100,000	40.2	70.5	56
Lincoln	53.2	100,000	44.2	63.9	127
Whatcom	52.4	100,000	49.4	55.5	1173
Wahkiakum	49.7	100,000	36.0	67.6	44
Walla Walla	48.4	100,000	44.1	52.9	495
Whitman	44.4	100,000	38.8	50.7	227
San Juan¶	39.9	100,000	32.6	49.1	110

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher

Data Sources:

Cancer Mortality Data:Washington State Department of Health, Center for Health Statistics

Population Estimates:

1990-2002: Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999;

1980-1989 ZIP Code and 1980-1986 Census Tract Population Estimates are based on figures from Claritas Corporation;

1987-1989 Census Tract Population Estimates are from Department of Social and Health Services, December 1995.

Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-16

Number of Deaths and Age-adjusted Cancer Death Rate*, Lung Cancer, Washington State, Counties and Vashon-Maury Island, 1980-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Pend Oreille	74.7	100,000	62.8	88.3	144
Mason	73.2	100,000	67.4	79.4	622
Grays Harbor	72.2	100,000	67.7	76.9	986
Pacific	71.2	100,000	63.9	79.2	378
Klickitat	66.9	100,000	58.3	76.6	218
Clark	64.1	100,000	61.6	66.8	2422
Lewis	64.1	100,000	59.7	68.8	810
Cowlitz	62.4	100,000	58.5	66.5	978
Okanogan	62.2	100,000	56.3	68.5	413
Skamania	61.2	100,000	48.5	76.9	84
Jefferson	60.9	100,000	54.3	68.3	328
Kitsap	60.0	100,000	57.2	62.9	1762
Garfield	59.6	100,000	41.7	84.6	38
Pierce	59.5	100,000	58.0	61.2	5455
Chelan	59.4	100,000	54.9	64.1	671
Franklin	59.3	100,000	53.0	66.4	327
Clallam	59.1	100,000	55.1	63.3	861
Yakima	58.6	100,000	56.0	61.2	2021
Benton	58.3	100,000	54.6	62.2	973
Snohomish	58.3	100,000	56.4	60.2	3848
Spokane	58.0	100,000	56.2	59.9	3883
Island	57.9	100,000	53.3	62.9	626
Thurston	57.8	100,000	55.0	60.8	1566
Stevens	57.4	100,000	51.2	64.0	323
Ferry	57.3	100,000	43.5	74.9	60
State Total	57.2	100,000	56.7	57.8	47185
Asotin	56.9	100,000	49.5	65.3	217
VASHON ISLAND	56.8	100,000	46.0	69.8	97
Skagit	56.7	100,000	53.1	60.5	939
Grant	54.7	100,000	50.2	59.6	549
Kittitas	54.7	100,000	48.3	61.8	267
King	53.8	100,000	52.8	54.7	13014
Douglas	52.4	100,000	45.9	59.6	242
Columbia	50.1	100,000	37.2	66.7	52
Adams	49.2	100,000	40.3	59.6	109
Whatcom	48.5	100,000	45.7	51.5	1088
Lincoln	46.9	100,000	38.4	57.0	111
Wahkiakum	45.3	100,000	32.3	62.6	40
Walla Walla	44.1	100,000	40.1	48.5	451
Whitman	41.2	100,000	35.8	47.3	211
San Juan¶	34.7	100,000	28.0	43.2	98

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher

Data Sources:

Cancer Mortality Data:Washington State Department of Health, Center for Health Statistics

Population Estimates:

1990-2002: Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999;

1980-1989 ZIP Code and 1980-1986 Census Tract Population Estimates are based on figures from Claritas Corporation;

1987-1989 Census Tract Population Estimates are from Department of Social and Health Services, December 1995.

Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-17

Number of Deaths and Age-adjusted Cancer Death Rate*, Bladder Cancer, Washington State, Counties and Vashon-Maury Island, 1980-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Skamania	7.3	100,000	3.2	14.7	9
Adams	6.9	100,000	3.8	11.7	14
Grant	6.9	100,000	5.3	9.0	60
Lincoln	6.3	100,000	3.6	10.8	16
Pacific	6.2	100,000	4.2	9.0	33
Franklin	6.0	100,000	4.1	8.7	31
Mason	6.0	100,000	4.3	8.2	43
Jefferson	5.9	100,000	4.0	8.7	32
Clallam	5.7	100,000	4.5	7.2	82
Garfield	5.7	100,000	1.6	18.3	4
San Juan	5.2	100,000	2.6	10.0	12
Cowlitz	5.1	100,000	4.0	6.4	77
Island	5.0	100,000	3.7	6.8	49
Kitsap	4.9	100,000	4.1	5.8	135
Spokane	4.9	100,000	4.3	5.4	322
Grays Harbor	4.8	100,000	3.7	6.1	64
Pierce	4.8	100,000	4.3	5.2	406
Kittitas	4.7	100,000	2.9	7.2	22
State Total	4.6	100,000	4.4	4.8	3602
Asotin	4.6	100,000	2.7	7.5	18
King	4.6	100,000	4.3	4.9	1057
Yakima	4.6	100,000	3.9	5.4	154
Chelan	4.5	100,000	3.4	6.0	52
Clark	4.4	100,000	3.7	5.2	154
Lewis	4.4	100,000	3.3	5.8	55
Thurston	4.4	100,000	3.6	5.3	112
Wahkiakum	4.4	100,000	1.2	12.6	4
Okanogan	4.3	100,000	2.8	6.2	27
Walla Walla	4.2	100,000	3.1	5.8	44
Douglas	4.0	100,000	2.3	6.5	18
Snohomish	4.0	100,000	3.5	4.5	241
Benton	3.8	100,000	2.9	5.0	57
Stevens	3.8	100,000	2.3	5.9	20
Whatcom	3.8	100,000	3.0	4.7	85
VASHON ISLAND	3.8	100,000	1.4	8.8	6
Ferry	3.7	100,000	0.7	12.0	3
Columbia	3.4	100,000	0.9	10.3	4
Skagit	3.4	100,000	2.6	4.5	56
Whitman	3.2	100,000	1.8	5.3	16
Klickitat	3.1	100,000	1.5	5.8	10
Pend Oreille	2.2	100,000	0.6	6.0	4

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher

Data Sources:

Cancer Mortality Data:Washington State Department of Health, Center for Health Statistics

Population Estimates:

1990-2002: Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999;

1980-1989 ZIP Code and 1980-1986 Census Tract Population Estimates are based on figures from Claritas Corporation;

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Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-18

Number of Deaths and Age-adjusted Cancer Death Rate*, Prostate Cancer, Washington State, Counties and Vashon-Maury Island, 1980-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
VASHON ISLAND	49.4	100,000	31.1	76.1	26
Garfield	44.7	100,000	22.6	82.2	12
Pend Oreille	43.0	100,000	29.3	61.5	33
Columbia	42.0	100,000	23.7	69.7	16
Lewis	41.9	100,000	36.3	48.2	209
Klickitat	41.4	100,000	30.5	55.4	52
Stevens	41.2	100,000	32.9	51.2	90
Adams	41.1	100,000	27.6	59.6	32
Franklin	41.1	100,000	32.1	52.4	80
Snohomish	37.9	100,000	35.3	40.7	840
Benton	37.5	100,000	32.2	43.5	207
Chelan	37.1	100,000	31.6	43.4	166
Skamania	36.8	100,000	21.3	60.8	19
Grant	36.7	100,000	30.6	43.9	142
Cowlitz	36.6	100,000	31.8	42.0	220
Jefferson	35.9	100,000	27.7	46.1	76
Kittitas	35.9	100,000	27.9	45.8	71
King	35.8	100,000	34.4	37.1	2951
Spokane	35.3	100,000	32.9	37.8	867
Asotin	35.1	100,000	26.4	46.0	56
State Total	35.0	100,000	34.3	35.7	10397
Kitsap	34.3	100,000	30.7	38.2	360
Thurston	34.3	100,000	30.6	38.4	335
Walla Walla	34.0	100,000	28.6	40.1	144
Pierce	33.8	100,000	31.7	36.0	1061
Whatcom	33.7	100,000	29.9	38.0	289
Grays Harbor	33.6	100,000	28.8	39.0	188
Whitman	33.6	100,000	26.1	42.6	72
Clark	33.2	100,000	30.0	36.6	440
Okanogan	33.0	100,000	26.4	41.0	90
Island	32.9	100,000	27.0	39.9	129
Clallam	32.5	100,000	27.9	37.8	195
Douglas	32.4	100,000	24.4	42.7	61
Yakima	31.9	100,000	28.9	35.2	435
Wahkiakum	31.7	100,000	16.2	57.5	12
Pacific	31.4	100,000	24.1	40.6	67
Mason	31.0	100,000	25.0	38.3	108
Skagit	30.8	100,000	26.6	35.6	202
Lincoln	30.4	100,000	20.8	43.6	33
San Juan	30.3	100,000	19.6	45.8	30
Ferry	19.1	100,000	7.4	43.1	7

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher

Data Sources:

Cancer Mortality Data:Washington State Department of Health, Center for Health Statistics

Population Estimates:

1990-2002: Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999;

1980-1989 ZIP Code and 1980-1986 Census Tract Population Estimates are based on figures from Claritas Corporation;

1987-1989 Census Tract Population Estimates are from Department of Social and Health Services, December 1995.

Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-19

Number of Deaths and Age-adjusted Cancer Death Rate*, Kidney Cancer, 1980-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Skamania	9.2	100,000	4.6	17.1	12
Jefferson	5.3	100,000	3.3	8.1	25
Grays Harbor	5.2	100,000	4.1	6.7	71
Kittitas	5.1	100,000	3.2	7.7	24
Cowlitz	5.0	100,000	4.0	6.3	77
Mason	4.9	100,000	3.4	6.7	40
Clark	4.8	100,000	4.1	5.6	178
Klickitat	4.8	100,000	2.7	8.0	15
Chelan	4.7	100,000	3.5	6.2	51
Okanogan	4.7	100,000	3.2	6.7	31
Whatcom	4.6	100,000	3.8	5.7	102
Clallam	4.4	100,000	3.4	5.8	62
Columbia	4.4	100,000	1.4	11.8	5
Grant	4.4	100,000	3.1	6.1	41
Island	4.4	100,000	3.2	6.0	46
Lewis	4.4	100,000	3.2	5.8	52
Skagit	4.4	100,000	3.4	5.6	72
Benton	4.3	100,000	3.3	5.5	72
Douglas	4.3	100,000	2.5	6.9	19
Walla Walla	4.3	100,000	3.1	5.9	43
Franklin	4.2	100,000	2.5	6.5	21
Pierce	4.2	100,000	3.8	4.6	379
Garfield	4.1	100,000	0.8	16.1	3
State Total	4.0	100,000	3.9	4.2	3262
Snohomish	4.0	100,000	3.5	4.5	261
Spokane	3.9	100,000	3.5	4.4	258
Yakima	3.8	100,000	3.2	4.5	128
King	3.7	100,000	3.4	3.9	883
Kitsap	3.7	100,000	3.1	4.5	111
Thurston	3.6	100,000	2.9	4.4	97
Ferry	3.5	100,000	0.7	11.4	3
Lincoln	3.3	100,000	1.4	7.1	8
Stevens	3.2	100,000	1.9	5.2	18
San Juan	2.9	100,000	1.2	6.9	8
Asotin	2.8	100,000	1.4	5.3	11
Pacific	2.8	100,000	1.5	5.0	15
Whitman	2.2	100,000	1.1	4.1	11
Adams	2.0	100,000	0.7	5.0	5
VASHON ISLAND	2.0	100,000	0.4	6.3	3
Pend Oreille	1.7	100,000	0.3	5.3	3
Wahkiakum	1.0	100,000	0.0	7.7	1

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher

Data Sources:

Cancer Mortality Data:Washington State Department of Health, Center for Health Statistics

Population Estimates:

1990-2002: Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999;

1980-1989 ZIP Code and 1980-1986 Census Tract Population Estimates are based on figures from Claritas Corporation;

1987-1989 Census Tract Population Estimates are from Department of Social and Health Services, December 1995.

Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Table D-20

Number of Deaths and Age-adjusted Cancer Death Rate*, Liver Cancer, Washington State, Counties and Vashon-Maury Island, 1980-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Ferry	5.0	100,000	1.6	13.1	5
Mason	3.6	100,000	2.4	5.3	30
Klickitat	3.1	100,000	1.5	5.9	10
Walla Walla	3.1	100,000	2.1	4.4	31
Grays Harbor	3.0	100,000	2.1	4.1	38
Stevens	3.0	100,000	1.7	4.9	16
Garfield	2.9	100,000	0.4	14.7	2
Kittitas	2.9	100,000	1.6	5.0	14
Thurston	2.9	100,000	2.3	3.6	77
Benton	2.8	100,000	2.1	3.8	47
King	2.8	100,000	2.6	3.1	687
Pierce	2.7	100,000	2.4	3.1	249
Snohomish	2.7	100,000	2.3	3.1	172
Yakima	2.7	100,000	2.2	3.4	93
VASHON ISLAND	2.7	100,000	0.7	7.4	4
State Total	2.6	100,000	2.5	2.7	2125
Grant	2.6	100,000	1.7	4.0	24
Lincoln	2.6	100,000	0.9	6.3	6
Okanogan	2.6	100,000	1.5	4.2	17
Lewis	2.5	100,000	1.6	3.6	30
Spokane	2.5	100,000	2.1	2.9	165
Cowlitz	2.4	100,000	1.7	3.3	36
Pend Oreille	2.4	100,000	0.6	6.4	4
San Juan	2.4	100,000	0.8	6.4	6
Whitman	2.4	100,000	1.2	4.3	12
Skagit	2.3	100,000	1.6	3.2	38
Whatcom	2.3	100,000	1.7	3.1	53
Clark	2.2	100,000	1.7	2.7	81
Franklin	2.2	100,000	1.2	3.9	13
Pacific	2.2	100,000	1.1	4.3	11
Asotin	2.1	100,000	0.9	4.5	8
Adams	2.0	100,000	0.5	5.2	4
Clallam	2.0	100,000	1.3	3.0	29
Kitsap	2.0	100,000	1.5	2.6	59
Columbia	1.8	100,000	0.2	8.2	2
Douglas	1.8	100,000	0.8	3.6	9
Island	1.7	100,000	1.0	2.8	19
Chelan	1.6	100,000	0.9	2.6	17
Jefferson	1.6	100,000	0.7	3.5	8
Skamania	1.3	100,000	0.2	6.3	2
Wahkiakum	1.0	100,000	0.0	7.7	1

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher

Data Sources:

Cancer Mortality Data:Washington State Department of Health, Center for Health Statistics

Population Estimates:

1990-2002: Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999;

1980-1989 ZIP Code and 1980-1986 Census Tract Population Estimates are based on figures from Claritas Corporation;

1987-1989 Census Tract Population Estimates are from Department of Social and Health Services, December 1995.

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Table D-21

Number of Deaths and Age-adjusted Cancer Death Rate*, Non-Melanoma Skin Cancer, 1980-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER
Skamania	1.5	100,000	0.2	6.7	2
Garfield	1.3	100,000	0.0	12.5	1
Kittitas	1.2	100,000	0.4	2.7	6
Stevens	1.2	100,000	0.5	2.6	7
Wahkiakum	1.2	100,000	0.0	8.2	1
Columbia	1.0	100,000	0.0	7.1	1
Klickitat	1.0	100,000	0.2	3.0	3
Okanogan	1.0	100,000	0.4	2.2	6
Douglas	0.9	100,000	0.2	2.6	3
Franklin	0.9	100,000	0.3	2.4	5
Kitsap	0.9	100,000	0.6	1.3	24
Skagit	0.9	100,000	0.5	1.5	14
Adams	0.8	100,000	0.1	3.3	2
King	0.8	100,000	0.7	0.9	182
Lewis	0.8	100,000	0.4	1.6	10
Pacific	0.8	100,000	0.2	2.4	4
Spokane	0.8	100,000	0.6	1.1	53
State Total	0.7	100,000	0.6	0.8	563
Benton	0.7	100,000	0.4	1.4	11
Clark	0.7	100,000	0.4	1.0	24
Grant	0.7	100,000	0.3	1.7	6
Jefferson	0.7	100,000	0.1	2.3	3
Pend Oreille	0.7	100,000	0.0	3.8	1
Pierce	0.7	100,000	0.5	0.9	61
Thurston	0.7	100,000	0.4	1.1	18
Walla Walla	0.7	100,000	0.3	1.5	8
VASHON ISLAND	0.7	100,000	0.0	4.4	1
Chelan	0.6	100,000	0.2	1.4	7
Island	0.6	100,000	0.2	1.4	6
Snohomish	0.6	100,000	0.5	0.9	40
Whatcom	0.6	100,000	0.3	1.1	13
Asotin	0.5	100,000	0.1	2.2	2
Clallam	0.5	100,000	0.2	1.2	8
Grays Harbor	0.5	100,000	0.2	1.1	7
Mason	0.5	100,000	0.1	1.5	4
Cowlitz	0.4	100,000	0.1	0.8	6
Yakima	0.4	100,000	0.2	0.7	13
Whitman	0.2	100,000	0.0	1.2	1

*Rates are adjusted to the 2000 U.S. Population Standard
^CL is Confidence Limit
†Vashon Island rate significantly lower
¶Vashon Island rate significantly higher

Data Sources:

Cancer Mortality Data:Washington State Department of Health, Center for Health Statistics

Population Estimates:

1990-2002: Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999;

1980-1989 ZIP Code and 1980-1986 Census Tract Population Estimates are based on figures from Claritas Corporation;

1987-1989 Census Tract Population Estimates are from Department of Social and Health Services, December 1995.

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Table D-22

Number of Cases and Age-adjusted Cancer Mortality Rate*
Selected Types, North Vashon Island and South Vashon-Maury Island,¶
1990-1998 Average

			*95% CL^*		
PLACE	RATE*	PER	LOWER	UPPER	NUMBER†
North Vashon Island	97.2	100,000	70.8	131.2	45
South Vashon-Maury Island	51.1	100,000	30.9	82.7	20

*Rates are adjusted to the 2000 U.S. Population Standard
¶North Vashon Island is census tract 277.01;South Vashon-Maury Island is census tract 277.02
^CL is Confidence Limit
†Three deaths could not be assigned to a census tract because of insufficient address information,
and are not included in the totals.
Selected cancer types include lung, bladder, kidney, liver, prostate and non-melanoma skin cancer (see text for details)

Data Sources:
Cancer Mortality Data: Washington State Department of Health, Center for Health Statistics
Population Estimates:
1990-2002: Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999;
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Table D-23

Cancer Incidence (1992-1998) and Mortality (1990-1998) by Type, North Vashon Island and South Vashon-Maury Island

	Incidence^				Mortality†			
	North Vashon¶		*South Vashon-Maury¶*		*North Vashon¶*		*South Vashon-Maury¶*	
Cancer Type	Rate*	Number	Rate*	Number	Rate*	Number	Rate*	Number
Lung	76.0	28	28.1	9	67.7	32	34.1	14
Bladder	21.5	8	36.1	11	4.5	2	2.3	1
Prostate	158.3	27	225.8	33	71.1	9	32.6	5
Kidney	0.0	0	5.8	2	2.3	1	0.0	0
Liver‡	0.0	0	0.0	0	1.9	1	0.0	0
Skin	N/A	N/A	N/A	N/A	0.0	0	0.0	0

N/A is data not available (the cancer registry does not collect information on non-melanoma skin cancer).

^Twelve cases could not be assigned to a census tract beause of insufficient address information, and are not included in the totals.
†Three deaths could not be assigned to a census tract because of insufficient address information, and are not included in the totals.
¶North Vashon Island is census tract 277.01;South Vashon-Maury Island is census tract 277.02
*Rates are age-adjusted to the 2000 U.S. Population Standard.
‡Liver cancer incidence includes angiosarcoma only; liver cancer mortality includes all liver cancers (see text for details).
The differences between North Vashon and South Vashon-Maury Island are not statistically signficant.

Data Sources:
Cancer Mortality Data: Washington State Department of Health, Center for Health Statistics
Cancer Indcidence Data: Washington State Cancer Registry
Population Estimates:
1990-2002: Department of Social and Health Services, Washington State Adjusted Population Estimates, April, 1999;
Prepared by Epidemiology, Planning and Evaluation Unit, Public Health - Seattle & King County, 12/00

Figure 1
Census Tracts on Vashon-Maury Island