WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Washington State
Septage Management Review

February 2001
Publication No. 01-07-005

printed on recycled paper

Washington State
Septage Management Review

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February 2001
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I. Background

An on-site sewage treatment system typically consists of two parts: a septic tank in which sewage is treated by anaerobic bacteria, and a drainfield system where the treated wastewater is discharged into the ground. Residual solids are held in the tank and periodically removed by a pumper truck. The first on-site systems were used in the United States beginning in 1884.[1] They were originally developed to provide sewage/wastewater treatment for rural farms that had indoor plumbing. The purpose of septic systems was to limit the family's contact with wastewater, thus protecting the health of the family.[2] Prior to this, outhouses or outdoor pit latrines were the most common means of human waste management, and the possibility of disease transmission through insects or groundwater contamination was much greater. Early on, septic system designs were not very sophisticated and failures were relatively common. Local officials were not overly concerned with system failures because of the sparse number of these systems and the isolation of many farms.[3]

> *"The American housing "boom" that followed World War II outpaced the construction of sewers. Subdivisions sprang up rapidly with the intention that they would soon be sewered. The septic tank system used by farmsteads was the only method available to "dispose" of wastewater in the interim. Unfortunately, existing design guidelines and regulatory agencies were not adequate to handle the demand. Failures became commonplace before sewers could be installed. With higher housing densities, public health problems and nuisances were significant. The belief that on-site systems are failure-prone became widespread. The U.S. Public Health Service began an earnest investigation of better siting and design guidelines for septic systems in the late 1940's. Yet, septic systems remain problematic in many areas of the country".*[4]

The capacity of an area to accommodate septic systems and manage septage is a matter of concern. If populations increase in suburban and rural areas that do not have the infrastructure to dispose of or recycle septage, what happens to it? This question becomes more critical if it can be assumed that population growth also means an increase in the number of septic systems used, especially if a regional sewage treatment plant was not designed with the capacity and/or the processes to handle septage. Population growth drives the need for waste management infrastructure in general, i.e. sewage/septage treatment facilities. The link between infrastructure and the on-site system is the septage hauler/pumper. After a septic system has been pumped, the septage is often taken to a sewage treatment plant for disposal. There are alternatives to disposal at sewage treatment plants that vary from state to state and from area to area within each state.

II. Introduction

Domestic septage can generally be thought of as domestic sewage (liquid and solid material) which is removed from a temporary holding facility. The following definitions were paraphrased from the Washington State Department of Ecology – Biosolids Management rule, Chapter 173-308 WAC.

> *Class I Septage: Liquid or solid material removed from domestic septic tanks, cesspools or similar treatment works that receive only domestic sewage, and that has had long enough residency time to be considered stabilized. Class I septage can include up to 25 percent Class II septage by volume or 25 percent (by volume) restaurant grease trap waste.*
>
> *Class II Septage: Liquid or solid material from portable toilets, pit toilets, RV holding tanks or other similar holding systems that receive only domestic sewage.*
>
> *Class III Septage: Liquid or solid material removed from industrial or commercial sewage systems but which the regulatory authority has determined to be domestic in quality.*

The purposes of this report are to describe and examine the processes by which domestic septage is managed in the state of Washington, identify problematic issues, highlight innovative efforts that are beneficial for septage management, and make recommendations for improving septage management in Washington State. This includes understanding how planning and population growth relates to septage management.

III. Septage Management in the Present

In 1980, 32.3 percent of all housing units in Washington were serviced by septic systems.[5] As of 1990, the number had declined slightly to 31.7 percent (Figure 1 below)[6]. The change in the number of housing units with septic systems from 1990 to present is not known. Service to the remaining 68% is provided by a sewer system connected to a sewage treatment plant. About 275 septage pumpers/haulers service households on septic systems in Washington State. There are currently about 325 sewage treatment plants in the state.[7] This includes all public and private facilities that deal with domestic waste.

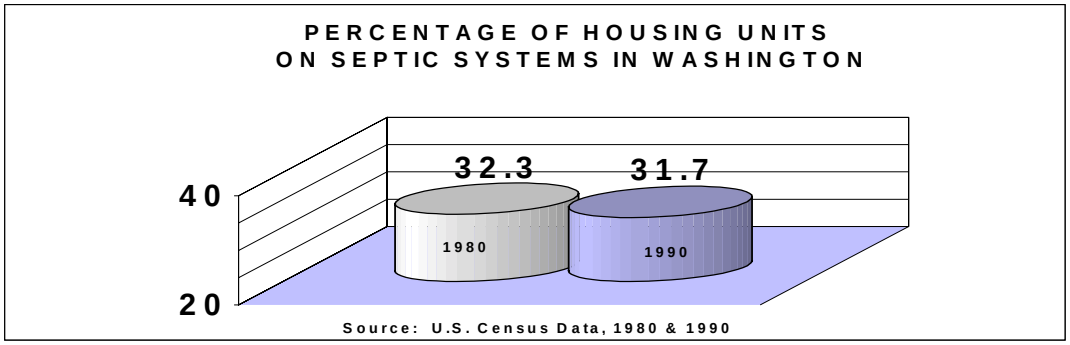


Figure 1

There are several different possible end points for recycling or disposal of septage. The methods of management noted below are being used in varying degrees of frequency throughout the state (see Figure 2 on page 4).

- Sewage treatment plants
- Direct land application without further treatment (but with injection or incorporation into the soil)
- Land application after further treatment (e.g. lime stabilization)
- Composting
- Disposal in surface impoundments, or landfill disposal (after dewatering)
- Illegal disposal (not an acceptable management option)

Although there are more than 300 sewage treatment plants in the state, many do not have the capacity and/or processes to treat certain characteristics of septage (e.g., grease and high biological oxygen demand), especially those that are required to handle stormwater runoff in the winter. In addition, treatment plants may refuse to accept septage at any given time. There are some facilities (particularly larger facilities) that do accept septage without problem on a regular basis.

Direct land application without further treatment - but with injection or incorporation into the soil - is a method of recycling septage. Application rates must be controlled to protect ground and surface waters. There are also restrictions on access to, and uses of the land, so that possible contact with pathogens will be avoided.

Disposal of septage in surface impoundments, or of dewatered septage in landfills is possible. Disposal is discouraged in Washington however, which has a statutory preference for recycling (temporary storage in an impoundment or holding system prior to land application is an acceptable practice). Illegal disposal – i.e. the unregulated discharge of septage onto the land or into the waters of the state - has the greatest potential for adverse impacts on public health and the environment because of a lack of physical safeguards and regulatory oversight. Illegal disposal is not an acceptable method of septage management and this report does not propose to condone or support this activity.

Composting and land application after stabilization can be efficient, cost effective methods of managing septage, but they have not been commonly used in Washington in the past. These alternatives to disposal through a sewage treatment plant are typically less expensive in terms of capital costs and maintenance than a sewage treatment plant, and restrictions on use of the final product are typically less stringent than those for direct land application. The following section describes three effective alternative septage recycling methods that are currently being used in Washington.

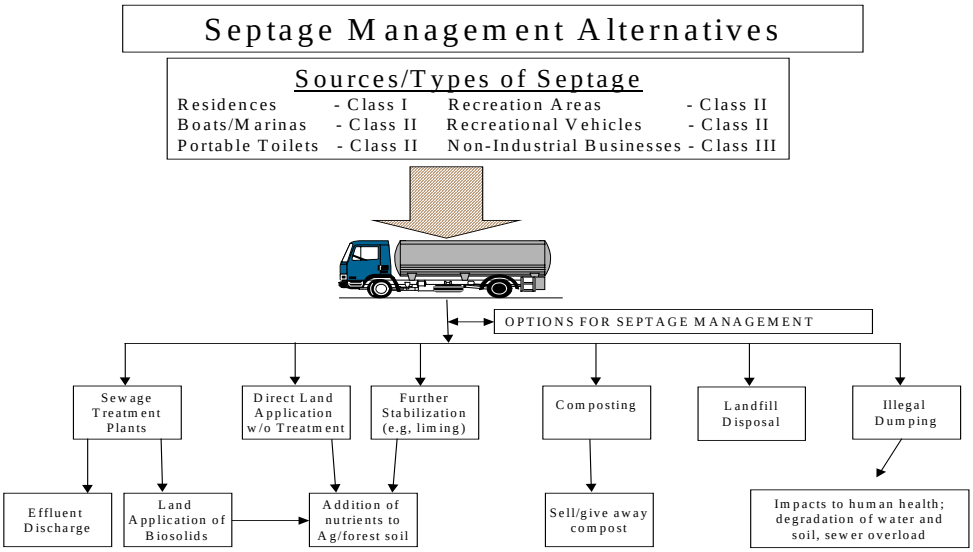


Figure 2

IV. Alternative Septage Management Methods

A majority of the septage in Washington State is disposed of at sewage treatment plants or is applied to the land … sometimes with and sometimes without additional treatment beyond what occurs in the holding system. In this section we will discuss some non-traditional methods for managing septage. These methods are being featured because they are expected to have relatively low capital costs as compared with the construction and management of new sewage treatment plants, or even upgrading of existing treatment plants, and because they are compatible with good environmental management practices.

Composting

Composting is the conversion of a mixture of organic materials such as vegetable refuse, septage, manures, etc., into a humus-like product for fertilizing and/or conditioning the soil. Composting is a thermophilic process and involves the cultivation of heat producing microorganisms in the initial stage of composting. The heat produced by the microbes is sufficient to destroy human pathogens present in septage.[8] By composting with other organic residuals such as yard waste, septage can be converted into a new and useful product.

The Port Townsend Composting facility (City of Port Townsend, WA) is an example of a small to mid-scale composting operation which handles both treatment plant biosolids and septage. Yard wastes are mixed with de-watered septage in a 3:1 ratio and allowed to compost over a four-month period. Thermophilic temperatures reach between 140° and 160° F over three days, exceeding EPA requirements for pathogen reduction. The compost is sold to the public. The liquid from the dewatered septage is eventually pumped to an on-site artificial wetland and allowed to percolate into the ground in accordance with a state waste discharge permit. The process can accommodate approximately 20,000 gal of septage/week, including chemical toilet waste. In addition to providing a management option for septage, this facility also provides a way to process yard waste. The finished product is sold back to the public. This facility could process more septage but is limited by its dewatering capacity. The cost of the facility was $1.87 million dollars with an annual maintenance cost of $220,000. In 1998, septage handlers were charged $.095 dollars per gallon to discharge their loads.[9]

Lime Stabilization

The Bio-Recycling facility (Centralia, WA) illustrates another method for beneficial use of septage. This facility accepts septage, screens it and then adds lime so that the pH is raised to 12 for 2 hours, followed by an additional 22 hours at a pH of at least 11.5. This process helps to reduce odor and pathogens present in the septage. Screenings are removed to a landfill, and the liquid is applied (sprayed) to pasture land. In 1998, septage handlers were charged approximately $.0575 dollars per gallon to discharge their septage at the facility. Groundwater and surface water quality are monitored at the application site.[10]

Aerobic Digestion – Aeration

An aeration facility on Whidbey Island processes septage until it is suitable for land application. The process involves aerating the septage (air pumped through at 104 degrees F) so that competing microorganisms and unfavorable conditions will reduce pathogens and odors associated with the raw septage. The water (supernatant) that is removed from the septage is applied to forestland surrounding the facility. The processed septage is delivered via tanker truck to a local farm for land application. The facility cost including tanker truck and equipment was $1.5 million dollars with an annual maintenance cost of $100,000 dollars. The facility currently processes about 2.25 million gallons of septage per year from 18,000 homes, with a design capacity of about 3 million gallons of septage per year. In 1998, septage handlers were charged $0.152 dollars per gallon (of septage unloaded).[11]

These three alternative septage management systems are helping to relieve capacity problems of sewage treatment plants in their respective geographic areas. These facilities also have comparatively low capital and maintenance costs compared to those of a fully operational sewage treatment plant. There is more opportunity for private sector involvement and public-private partnerships because of the relatively low costs of developing these types of facilities.

V. Septage Management Survey Summary

In order to gain a better understanding of septage management across the state, 22 county health officials and 19 septage pumping/hauling business representatives were interviewed in early 1998 about various aspects of the septage handling industry.

In interviewing the septage handlers, 9 of the 19 (47%) surveyed said there were too few facilities that would accept septage for disposal. Eight of those nine septage handlers operated their businesses in rural parts of western Washington counties exclusively. Seven of the 19 (approximately 37%) of the septage handlers interviewed said there was a need for more facilities that will accept septage, just so that their transportation costs would decrease.

Issues of sewage treatment plant capacity are perhaps even more critical in the island areas of western Washington because of the combined effects of geography and population growth. In eastern Washington, distance traveled by a septage handler was more of an issue. Permit fees for land application sites and compliance with regulations were also noted as concerns at the time the interviews were conducted.

Based on the interviews with septage pumpers and haulers, the following concerns were identified as impediments to a more successful business:

- Increasingly high fees charged by facilities that will accept septage.
- Too few facilities that will accept septage (some only accept it seasonally).
- Transportation difficulties (fuel costs, distance, etc.).
- Compliance with state and federal regulations.

These responses are in the order of most to least frequency as stated by the interviewees. If left unresolved, all of these reported difficulties can lead to a variety of septage management and environmental problems in the future.

Information from interviews with 22 county health officials also broadened our understanding of current septage management practices in Washington State. The following observations summarize their responses.

Most septage pumpers/handlers are licensed to pump and haul septage by the local jurisdictional health department (permitting of actual land application sites is handled separately in a different process). They confirmed that not enough sewage treatment plants would accept septage on a consistent basis. Five of the 22 officials interviewed stated that sewage treatment plants in their jurisdiction do not accept septage on a regular basis and in some instances not at all. This would be a greater problem if land application opportunities were curtailed or eliminated in some counties.

Another issue that was deemed important by the county health officials was what to do with chemical toilet waste – especially in eastern Washington. Chemical toilets are typically portable devices, commonly used in agricultural, recreational, and construction settings to retain human waste and be periodically serviced by septage pumpers/haulers. Chemical toilet waste is not accepted at all land application sites or at all sewage treatment plants.

The cost of septage disposal across the state varies greatly. In 1998, fees reported ranged from three to twenty-five cents per gallon. County health departments have no control over how facilities that accept septage establish their pricing regimes, but if high prices and/or a lack of facilities in a region lead to illegal disposal, health departments may become involved by default because of their local licensing programs for pumpers. The division of responsibilities between state and local governments is subject to negotiation and too complex to describe here, but the Department of Ecology also has a regulatory role to play.

The amount of illegal disposal that occurs is not well known. Thus, it is difficult to say what impact it is having on human/environmental health – especially since it is not known precisely whether the septage is illegally disposed of in water, on land, pumped into existing sewer pipes, or a combination of all three. However, if septage was illegally disposed of in water or on land, there is potential for human exposure to pathogens and other pollutants. Fish and wildlife could be threatened as well. Currently, most counties have adequate regulations and procedures to deal with illegal septage disposal, but adequate resources do not always exist for appropriate monitoring or enforcement. In some areas of Washington, economic competition is intense enough so that the septage industry polices itself for illegal disposal activity.

VI. Demographics

By contrasting population growth with the proportion of households served by septic systems, a fuller picture of septage management under present circumstances emerges (Maps supporting this discussion are located in the appendix. See also Table 1, page 9). Between 1980 and 1990, 26 of 39 counties in Washington experienced increases in the numbers of households that were served by septic systems (see Map 1, top). All of the increases took place in counties that have predominately rural populations. Despite these statistics, there was a slight statewide decrease in

the percentage of households serviced by septic systems (0.6%) during the same time period (Figure 1).

Between 1980 and 1990 the following Washington State counties experienced a population growth rate greater than 15% (the average growth rate for all counties was 11.3%): Chelan, Clark, Douglas, Island, Jefferson, King, Kitsap, Mason, Pierce, San Juan, Skagit, Snohomish, Thurston, and Whatcom (see Map 1, bottom).[12]

Overall, Okanogan, Pacific, and Garfield counties had the largest increase in the percentage of households serviced by septic systems (between 1980-1990) at 11.6, 11.1, and 10.1 percent respectively. The population growth rates for these counties were less than the increase in the percentage of households serviced by septic systems (meaning that proportionately more households were being served by septic systems).

The following Washington State counties experienced a population growth rate of greater than 15% between 1990 and 1995: Benton, Clark, Franklin, Grant, Jefferson, Kitsap, Mason, San Juan, Skamania, Skagit, Thurston and Whatcom. Information on percentages of households on septic systems was not available for this time period (1990-1995) (see Map 3)[13]

Of these counties, the following have water bodies that appeared on the 303d list (a list of surface waters that require additional pollution control measures) in 1998 as being impaired by fecal coliform bacteria, ammonia-N and dissolved oxygen: Whatcom, Skagit, Kitsap, Mason, Thurston and Clark (see Map 3).[14]

No attempt was made at spatial or temporal correlation of the distribution of septic systems, sewage/septage disposal facilities, or the locations of impaired water bodies. However, according to the CWA 305b report (a biennial assessment of the current conditions of state surface waters) for 1998, 10% of the streams that were assessed statewide were polluted because of septic systems and approximately 7% because of municipal wastewater discharges. Fecal coliform, ammonia-N and dissolved oxygen were mapped because these are the most common pollution problems in water bodies contaminated with sewage/septage.[15] Of all stream miles assessed in Washington in the 305b Report for 1998, approximately 44% were impaired by fecal coliform bacteria, approximately 7% were impaired for dissolved oxygen and approximately 2% were impaired for ammonia.

Population Growth – 1980 – 1990 and 1990 – 1995 and Counties with impaired water bodies (303(d) list)

Washington State Counties with greater than 15% population growth (1980-1990)	Washington State Counties with greater than 15% population growth (1990-1995)	Counties with water bodies impaired by fecal coliform bacteria, ammonia-N & dissolved oxygen (1998).
Chelan, Clark, Douglas, Island, Jefferson, King, Kitsap, Mason, Pierce, San Juan, Skagit, Thurston, Whatcom	Whatcom, San Juan Island, Skagit, Jefferson, Kitsap, Mason, Thurston, Clark, Skamania, Grant, Benton, Franklin	Whatcom, Skagit, Kitsap, Mason, Thurston, Clark

Table 1

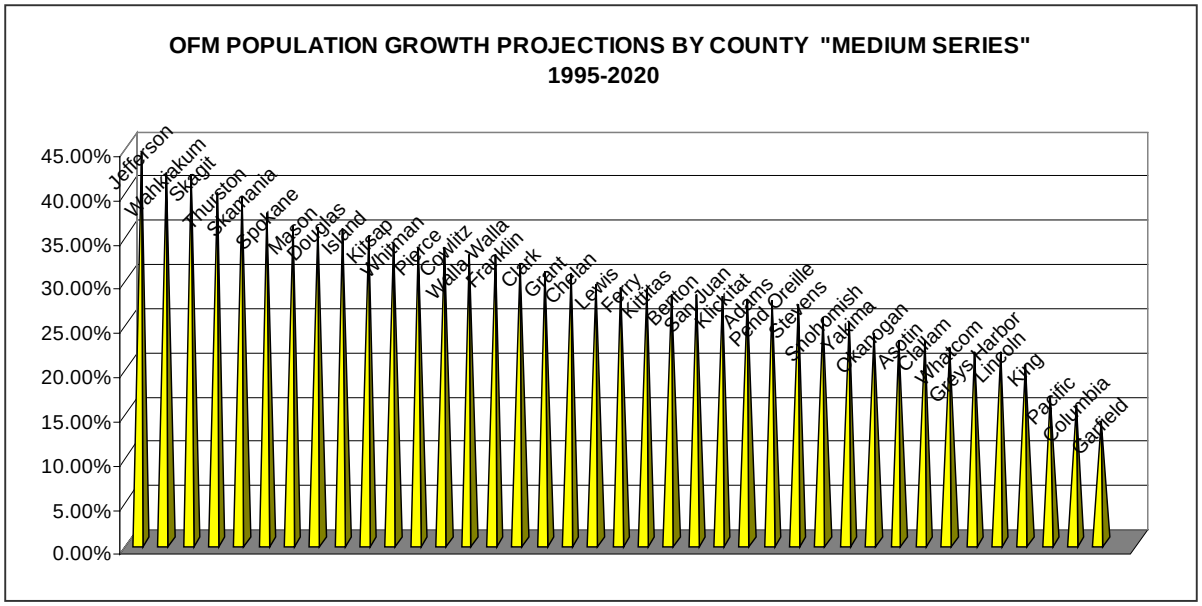
This information gives us a reasonable representation of what the septage management/sewage treatment industry faces in the present. Population growth rates over the last fifteen years seem to be causing some economic difficulties and capacity problems for the septage management/ sewage treatment industry in parts of the state. In most cases industry and county governments have been able to address the current need, but the system is strained and options are limited in some areas. What about the future?

VII. Future Conditions

Understanding population growth and growth patterns is the key to understanding a region's waste management needs. Septage management planning should be an integral part of population growth management. Because planning is generally decentralized in the United States - especially in the western United States, septage management planning may be disconnected from other aspects of population growth management (if it occurs at all). This section will look at population growth projections for Washington State for the next 15 and 25 years and how they may relate to septage management in the future.

The fifteen and twenty-five year population growth projections from the Washington State Office of Financial Management are depicted in Figures 3 and 4 on page 10 (see also Table 2 in the appendix). The "medium series" projection reflects the most likely population growth scenario. The year 2020 is a planning projection end-year which local governments can use to respond to various requirements of the state's Growth Management Act. The "high series" projection reflects uncertainty or possible deviation above the most likely ("medium") population projection. For the purpose of this report, the 15year "high series" list is used as a "worst case" scenario in terms of population growth per county.

Figure 3



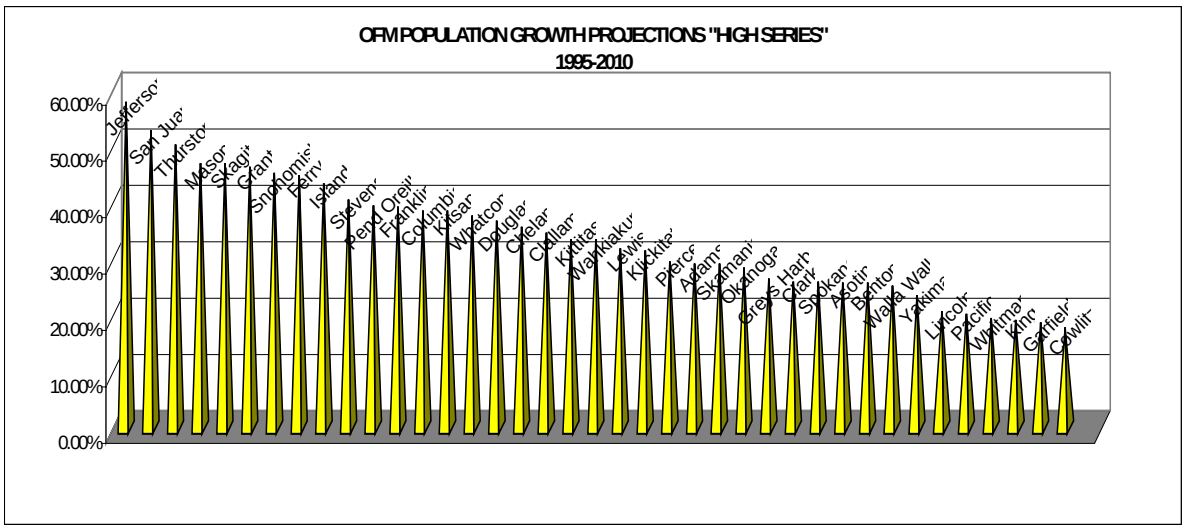


Figure 4

In order to summarize what this information means relative to septage management in the future, the following limitations must be acknowledged: 1) These figures are only projections subject to change due to many different variables. 2) The spatial distribution of the soil types in each county that could accommodate liquid from septage systems was not taken into account. 3) The capacity information on sewage treatment plants in each county was not available.

With those limitations in mind, the following observation can be made: Jefferson, Thurston and Skagit counties had population projections in the top quartile of both the 15 and 25-year population growth projections. These three counties had an overall increase in the percentage of households on septic systems between the same years compared to a statewide decrease in this category. Skagit and Thurston counties also have numerous polluted streams that are currently

impaired by fecal coliform bacteria, ammonia-N, and dissolved oxygen (as stated in the federal 303d list). Jefferson County has one water body on this list.

If populations in rural areas continue to increase, county officials and residents will need to decide whether they want their communities to continue to be rural or become more urban/sub-urban in character. Typically, the more urbanized an area becomes, the more need it has for infrastructure (sewers and sewage treatment facilities) to deal with its waste. Most soils and substrates have limited capacities to absorb water from residential septic systems. Only 32% of the land area nationwide has soil types suitable for drainage from septic systems.[16] Groundwater contamination is the typical result from poorly planned rural development with too many septic systems. Also, unrestricted population growth and development will strain the capacity of a local sewage treatment plant.

Between 1990 and 1994, statewide construction grants for sewage treatment plants totaled around $200 million per year or less.[17] In the 1980s, expenditures were almost five times this amount.[18] Statewide expenditures for construction grants to municipal sewage treatment plants continue to decline. Assuming that population growth and housing trends are reasonably accurate, and that the amount of infrastructure to deal with septage remains constant, we could expect more difficult septage management problems in the future.

Effective septage management must be addressed at two different levels: first at the urban/regional planning level (water quality planning also), and second at the disposal/discharge level. At the urban/regional planning level, long-range plans must account for residential growth so that over-burdened drain fields or improper disposal of septage do not threaten surface/ground water and drinking water resources. There must also be infrastructure (e.g. sewage treatment plants, alternative disposal systems) to deal with the quantities of septage that a community and its surrounding areas will generate.

The Washington State Growth Management Act (GMA) contains 13 planning goals to guide communities in comprehensive planning and/or the development of regulations pursuant to RCW 36.70A.040. Three of the goals have some relevance to septage management:

- " Urban Growth. Encourage development in urban areas where adequate public facilities and services exist or can be provided in an efficient manner."
- " Reduce sprawl. Reduce the inappropriate conversion of undeveloped land into sprawling low-density development."
- "Environment. Protect the environment and enhance the state's high quality of life, including air and water quality and the availability of water."

Throughout the GMA there are only general references for dealing with septage/sewage management. No specific directives are made. It is important to consider how local and regional planning efforts are coordinated with septage management. The Act does require local plans to include a capital facilities element, which might be tied to evaluation of septage management capacity. In any event, the GMA does not advise urban or rural communities on how to plan for and deal with waste from septic (on-site) systems. There may be a greater need for enhancement

of planning practices in regions of the state where the percentage of housing and business developments that depend on septic systems is increasing.

Insufficient planning for population growth and infrastructure for septage management makes degradation of water quality more likely. Indeed, leakage from improperly functioning septic systems has been linked to groundwater contamination and contamination of shellfish habitat. The following scenario of events leading to adverse impacts to the environment and public health could be realized if good septage management planning is not in place:

- Increased development/population growth occurs in statewide or in a region of the state.
- Sewage treatment plants and/or infrastructure to handle increasing volumes of septage/sewage is not planned for or provided.
- Septage pumpers/haulers are discouraged or restricted from disposing of septage locally because of lack of capacity of sewage treatment plants and alternative facilities.
- Increased travel time to more distant septage handling facilities and related costs cause more economic difficulties for the septage pumpers/haulers. Some illegal disposal may occur.
- Increased costs are passed on to homeowners and businesses.
- Homeowners and businesses may not have their septic systems pumped as often as they should because of increased costs.
- Natural resources (e.g., surface water, groundwater, shellfish habitat) may be contaminated because of a lack of septic system maintenance and/or illegal disposal.

This scenario has already occurred in varying degrees in some places, but it does not have to occur at all.

VIII. Summary and Recommendations

Population growth rates determine waste management needs of a region. Increased population growth rates without sufficient planning for, and establishment of infrastructure to handle septage causes economic hardship for the septage handling industry. It may also lead to increased incidences of illegal disposal, but this has not been well documented in Washington State. The scenario projected as the result of poor septage management planning does not have to occur. The following recommendations do not consider the cost of implementation or available resources, but if implemented would help prevent the foregoing scenario from developing:

➢ Communities and counties should develop appropriate septage management planning practices and protocol.

➢ Counties that are projected to experience population growth rates above the statewide average should put a special emphasis on planning with respect to future housing and business developments that will depend on septic systems.

- Communities/counties should implement their septage planning requirements before allowing future development. Septage/sewage handling infrastructure/capacity should be thoroughly reviewed every five years as part of this planning

- Incentives should be given for choosing septage management alternatives that emphasize re-use and recycling of septage.

- The development of non-traditional facilities like the composting facility in Port Townsend, the Bio-Recycling facility in Chehalis, and the aeration facility in Island County should be seriously considered and implemented where feasible. This will be especially important in those areas where numbers of households and businesses on septic systems are increasing and sewage treatment capacity is expected to remain limited.

- The Department of Ecology (Water Quality and Solid Waste and Financial Assistance Programs) could develop a septage management training module to provide adequate education for communities and counties about how to properly manage septage at a local level. This could include: problem assessment, project planning, coordination of stakeholders, education for the public and septage industry, incentives, funding sources, monitoring for future problems and establishment of success measures.

- A database that provides capacity information on all septage handling facilities and sewage treatment plants should be established.

- A database that provides information on illegal disposal activities or has the ability to estimate the scope of illegal disposal activities should also be established.

- Statewide isopleth maps depicting highest to lowest concentrations of septic system use should be developed and contrasted with available septage management alternatives.

Finally, it is worth noting that Governor Locke signed into law two new bills in the 1998 legislative session that could have a positive impact on septage management in Washington State. SHB 3056 authorized the Washington State Departments of Health and Licensing to develop a program for designers of on-site sewage systems. It also authorizes them to develop a proposed training program and certification for inspectors.[19] HB2717 authorized local governments to use revenues from sewer charges to improve septic systems in their jurisdictions. County governments should consider utilizing both these provisions to help improve septage management in their regions.[20]

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17, 18) *Washington State 1995 Data Book.* Washington State Office of Financial Management, 1995, page 154.

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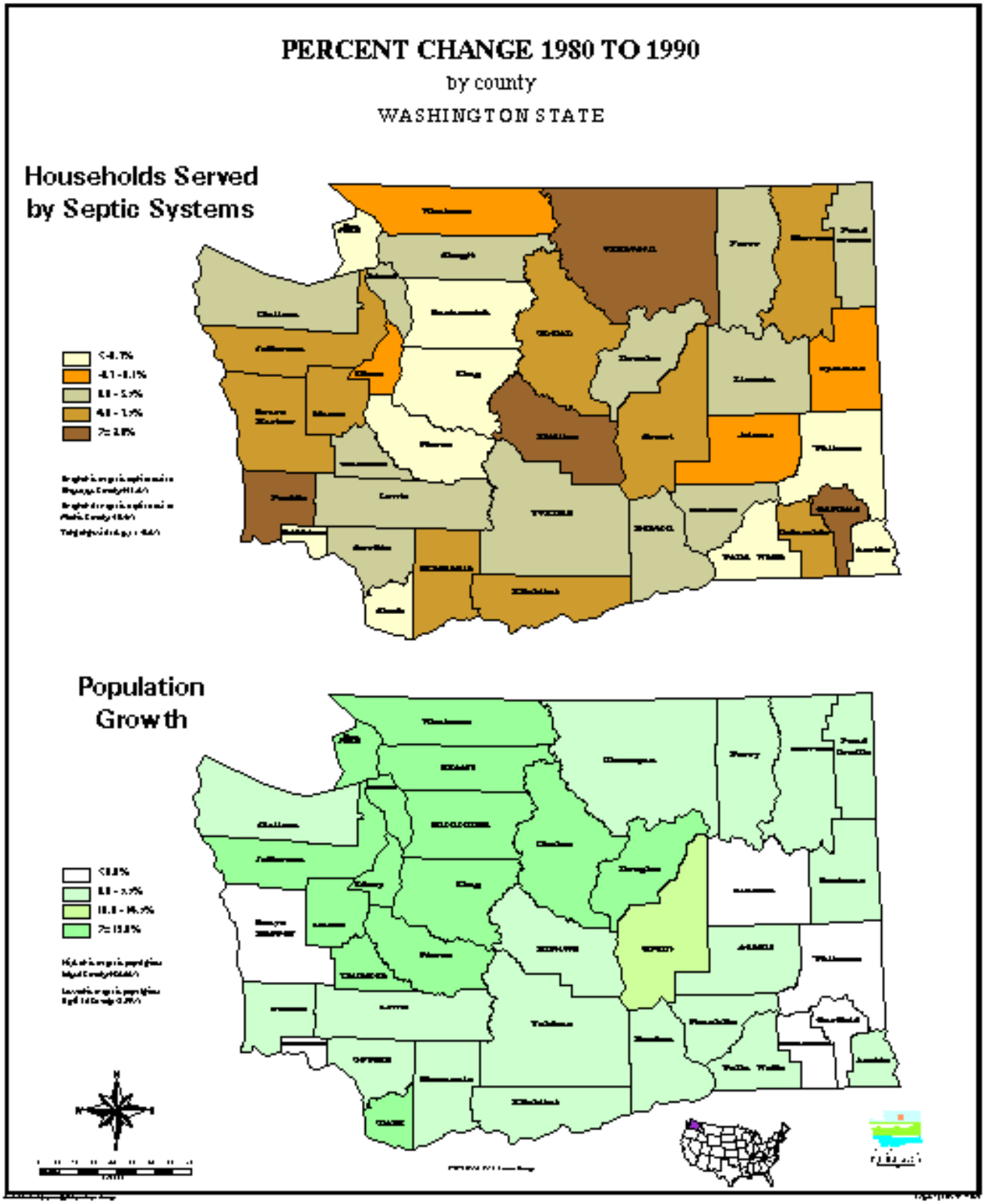
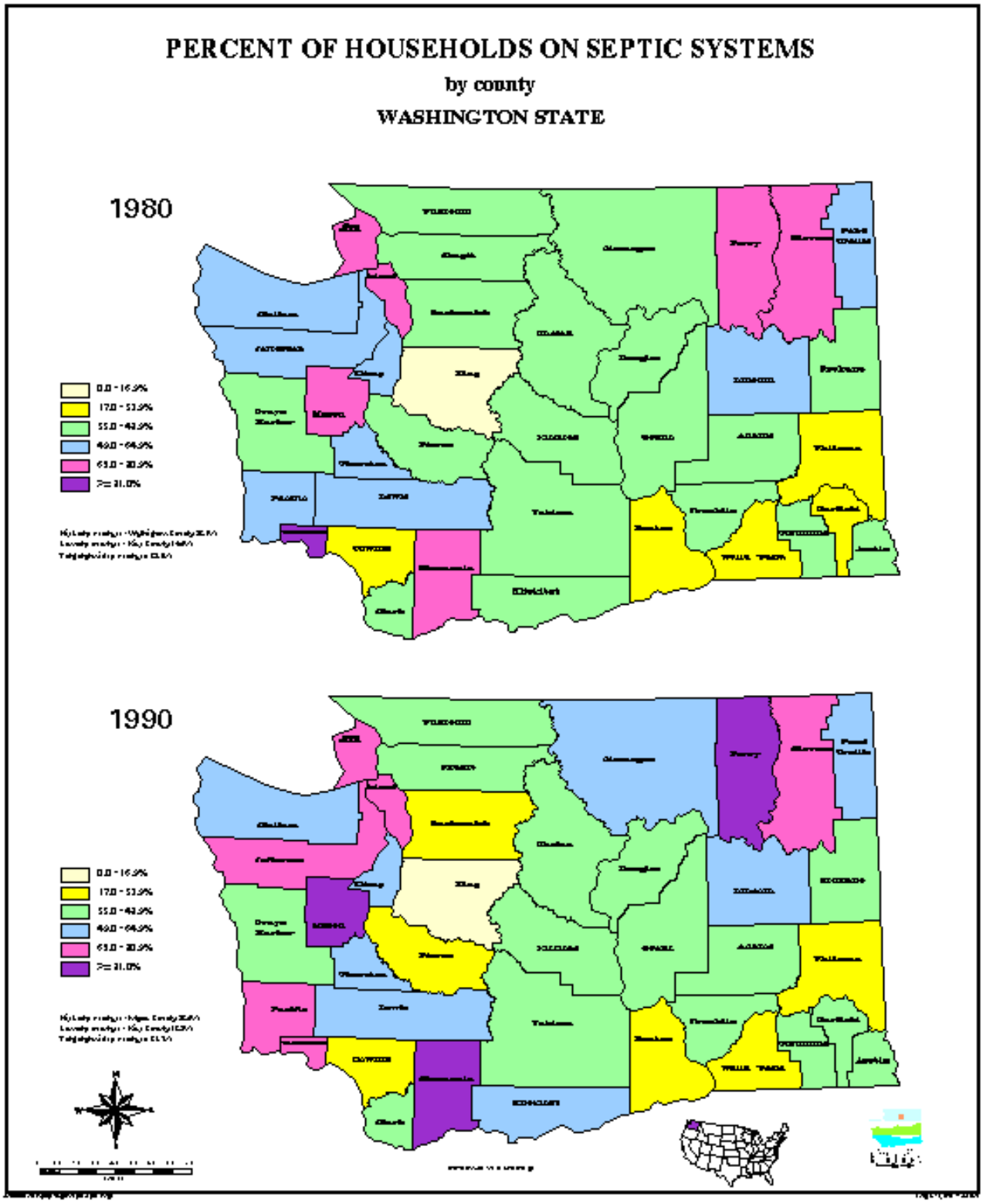
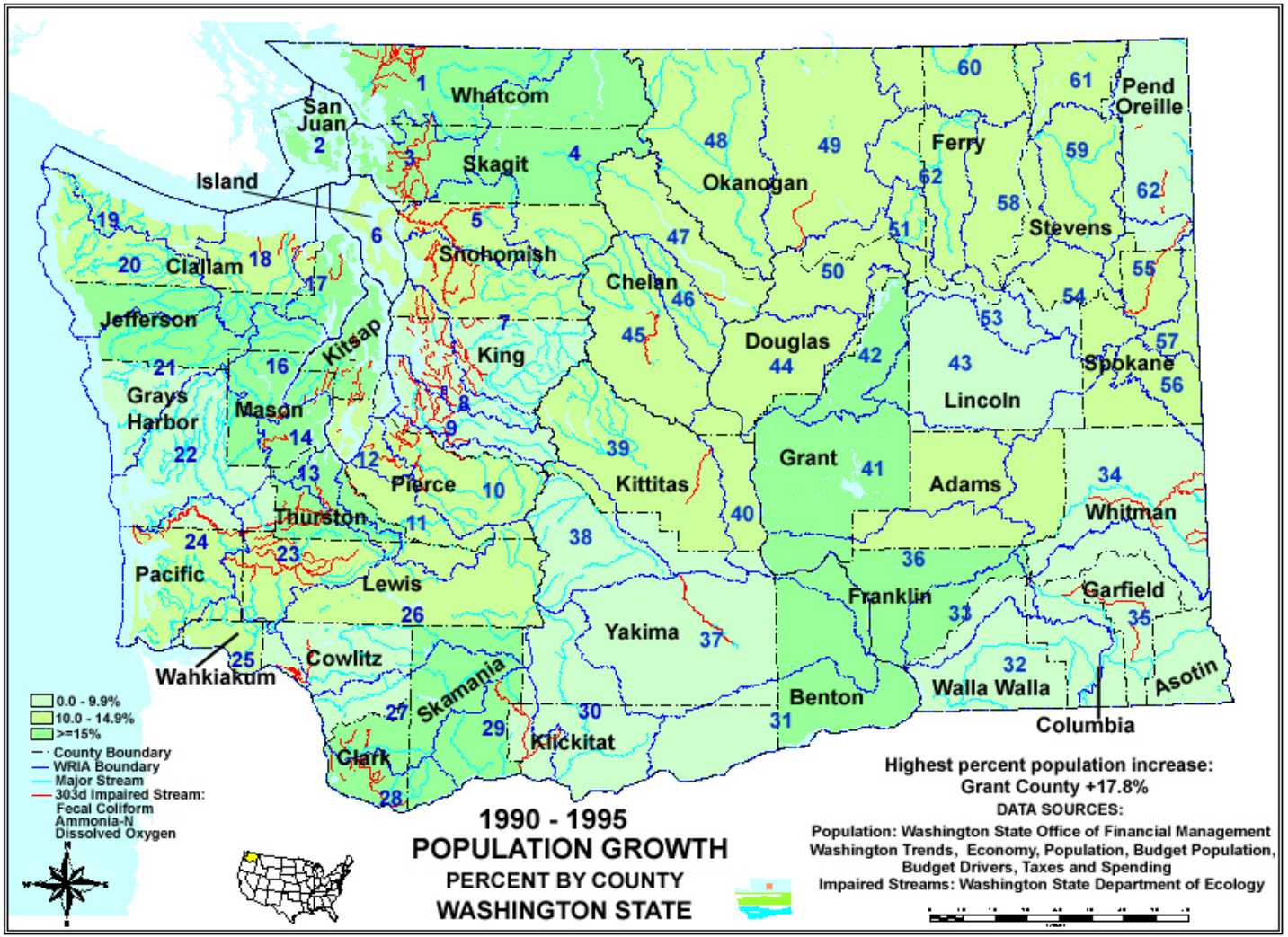
Appendix

Office of Financial Management Population Growth Projections

COUNTY NAME	15 YR GROWTH PROJECTIONS (HIGH SERIES 1995-2010)	COUNTY NAME	25YR GROWTH PROJECTIONS (MEDIUM SERIES 1995-2020)
Jefferson	57.70%	Jefferson	44.00%
San Juan	52.70%	Wahkiakum	41.80%
Thurston	50.10%	Skagit	41.70%
Mason	46.80%	Thurston	39.50%
Skagit	46.80%	Skamania	39.10%
Grant	46.20%	Spokane	37.20%
Snohomish	45.10%	Mason	35.80%
Ferry	44.70%	Douglas	35.60%
Island	43.20%	Island	35.40%
Stevens	40.40%	Kitsap	34.70%
Pend Oreille	39.30%	Whitman	33.90%
Franklin	39.10%	Pierce	33.40%
Columbia	38.40%	Cowlitz	33.30%
Kitsap	38.40%	Walla Walla	32.60%
Whatcom	37.50%	Franklin	32.50%
Douglas	36.60%	Clark	31.60%
Chelan	35.50%	Grant	30.60%
Clallam	34.50%	Chelan	30.40%
Kittitas	33.30%	Lewis	29.10%
Wahkiakum	33.30%	Ferry	28.90%
Lewis	31.70%	Kittitas	28.70%
Klickitat	31.30%	Benton	28.00%
Pierce	29.40%	San Juan	28.00%
Adams	29.00%	Klickitat	27.80%
Skamania	29.00%	Adams	27.60%
Okanogan	28.30%	Pend Oreille	27.40%
Grays Harbor	26.31%	Stevens	26.80%
Clark	25.80%	Snohomish	25.40%
Spokane	25.80%	Yakima	24.90%
Asotin	25.60%	Okanogan	23.70%
Benton	25.60%	Asotin	22.90%
Walla Walla	25.10%	Clallam	22.90%
Yakima	23.40%	Whatcom	22.00%
Lincoln	20.50%	Grays Harbor	21.60%
Pacific	20.10%	Lincoln	21.50%
Whitman	19.40%	King	20.10%
King	19.00%	Pacific	16.50%
Garfield	18.60%	Columbia	15.50%
Cowlitz	17.70%	Garfield	13.80%


PERCENT CHANGE 1980 TO 1990
by county
WASHINGTON STATE
Households Served by Septic Systems
Population Growth


PERCENT OF HOUSEHOLDS ON SEPTIC SYSTEMS
by county
WASHINGTON STATE
1980
1990


1990 - 1995
POPULATION GROWTH
PERCENT BY COUNTY
WASHINGTON STATE
0.0 - 9.9%
10.0 - 14.9%
>=15%
County Boundary
WRIA Boundary
Major Stream
303d Impaired Stream:
Fecal Coliform
Ammonia-N
Dissolved Oxygen
Highest percent population increase:
Grant County +17.8%
DATA SOURCES:
Population: Washington State Office of Financial Management
Washington Trends, Economy, Population, Budget Population, Budget Drivers, Taxes and Spending
Impaired Streams: Washington State Department of Ecology
Whatcom
San Juan Island
Skagit
Okanogan
Ferry
Pend Oreille
Stevens
Snohomish
Clallam
Jefferson
Kitsap
King
Chelan
Douglas
Lincoln
Spokane
Grays Harbor
Mason
Pierce
Thurston
Kittitas
Grant
Adams
Whitman
Pacific
Lewis
Yakima
Franklin
Garfield
Cowlitz
Wahkiakum
Skamania
Klickitat
Benton
Walla Walla
Columbia
Asotin
Clark