KITSAP COUNTY
INITIAL BASIN ASSESSMENT October 1997

With the multitudes of lakes, streams, and rivers, Washington State seems to have an abundance of water. The demand for water resources, however, has steadily increased each year, while the water supply has stayed the same, or in some cases, appears to have declined. This increased demand for limited water resources has made approving new water uses complex and controversial.

To expedite decisions about pending water rights, it is vital to accurately assess the quality and quantity of our surface and ground water. The Washington State Department of Ecology (Ecology) recognizes that water right decisions must be based on accurate scientific information.

Ecology is working with consultants and local governments to conduct special studies called Initial Watershed or Basin Assessments throughout the State. The assessments describe existing water rights, streamflows, precipitation, geology, hydrology, water quality, fisheries resources, and land use patterns.

The assessments evaluate existing data on water which will assist Ecology to make decisions about pending water right applications. The assessments do not affect existing water rights.

This report summarizes information detailed in the Kitsap County Initial Basin Assessment and represents the most current (1996) compilation, review, and analysis of water resources data including a peer review of the assessment (August 1996) for Kitsap County (County). Kitsap County is part of the Kitsap Peninsula Basin which has been designated by the state as Water Resource Inventory 15 (WRIA 15). This assessment was initiated and funded by Kitsap Public Utility District and conducted under a Memorandum of Agreement with Ecology.

This report summarizes information presented in the detailed Ecology Open File Technical Report No. 97-04. It also presents some actions that could be taken in response to the results of this assessment.

Economic and Engineering Services, Inc.

Kramer, Chin, and Mayo

Pacific Groundwater Group

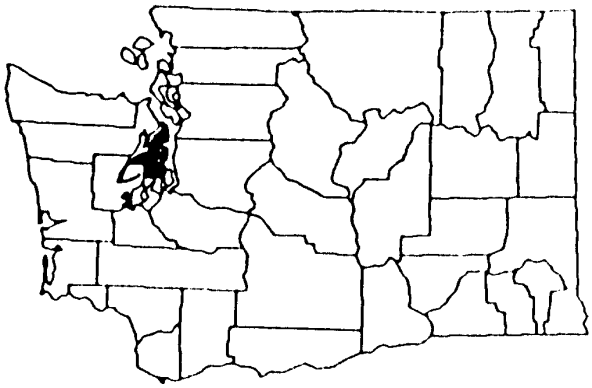
Robinson and Noble, Inc.

In Cooperation With

Washington State Department of Ecology

Funded By Kitsap Public Utility District

Kitsap County Watershed Location Map



What do we know about the Kitsap County Basin?

Kitsap County encompasses almost 400 square miles and occupies a peninsula and several islands in Puget Sound. It is bounded on the east and north by Puget Sound and Admiralty Inlet, and on the west by Hood Canal. The County is adjoined by Pierce and Mason Counties on the south, Jefferson County on the west, and King County on the east.

Because of the physiography of the County and the dominance of localized ground water and surface water flow systems, the most logical method for study of the hydrology or water resources is by subdividing the county into smaller subareas. Based upon the local geology, hydrology, and topography, 18 subareas have been identified within the County. Exhibit 1, on the following page, shows the 18 subareas designated for detailed water resource assessment. The designation of these subareas involved evaluation of both surface and subsurface information.

What are the water allocation issues?

- Ecology needs to make decisions on 220 pending (December 1995) water right applications located within the County. Accurate data are essential to making these water allocation decisions. If the decision is not to allocate, then infrastructure planning must be adjusted accordingly. Currently, there are 200 ground water applications for 41,530 gpm (92.5 cfs) and 20 surface water applications for 1616 gpm (3.6 cfs).

- There is no evidence of extensive seawater intrusion in the County, but localized seawater intrusion is found

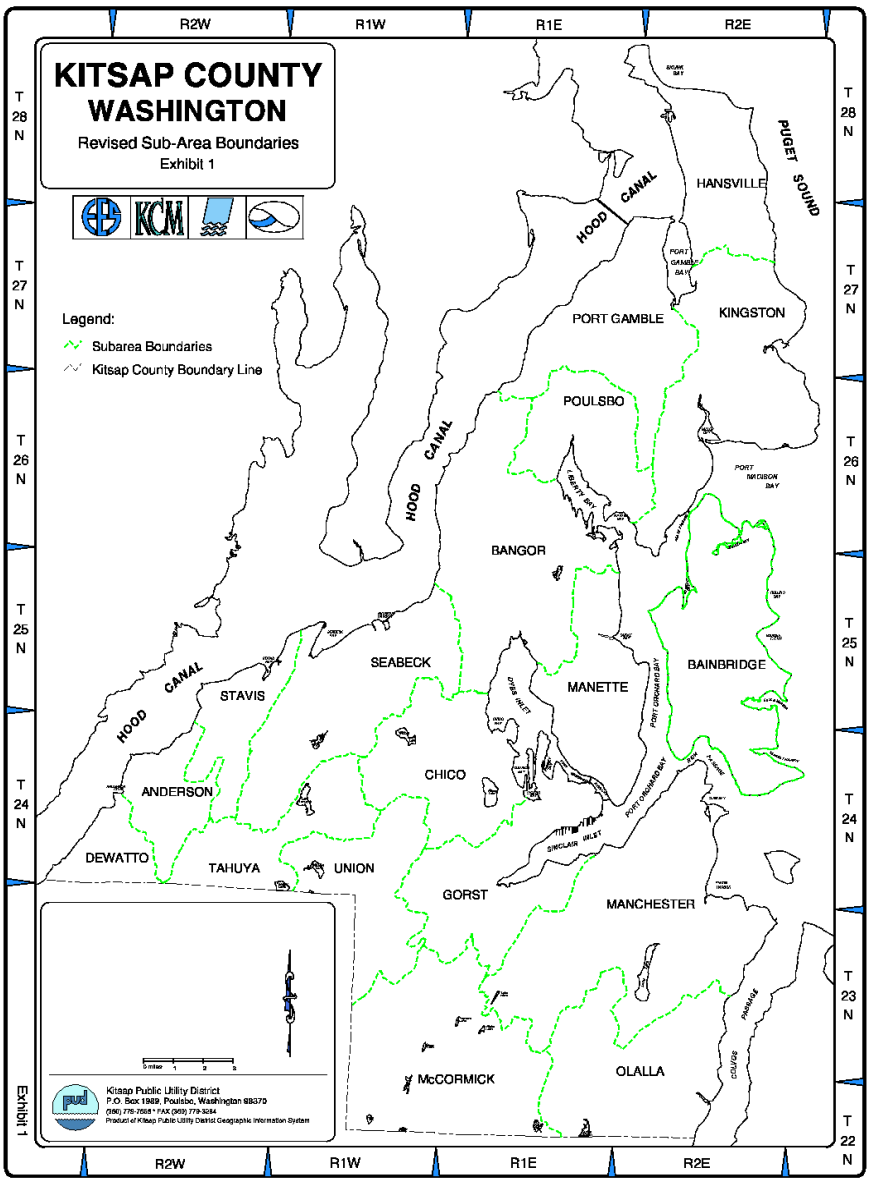
in a few areas such as Jefferson Beach (Kingston Subarea).

- Aquifer water levels since 1990 in general have followed precipitation trends. The period from 1991 through 1994 was generally characterized by below average precipitation and decreasing water levels. Water levels in 1995 and 1996 seem to respond to an above average period of precipitation. Long term water level data are generally not available, therefore detailed correlation between climate, water use and ground water system response will be conducted in the future.

- While there are no large river systems in the County, there are many small streams which are highly influenced by ground water and support a variety of fish populations. Escapements (the number of salmonids that make it back to spawn) in many creeks are generally not documented. Limited data has been collected with fish health in mind. Existing information does not provide an in-depth assessment of the overall fisheries habitat within the County, although studies by tribes are ongoing.

- Maintenance of streamflows necessary to preserve instream resources is a major concern. The state has set minimum instream flows for 14 rivers and creeks; established approximately 32 year-round closures, and 10 partial closures of streams, lakes, and drainage systems in Kitsap County. Prior to 1990, only five control points (established measurement locations as per Chapter 173-515 WAC) had associated gaging stations. Several of the original five gaging stations are no longer active. Approximately 20 other gaging stations have been established since 1990 at or near established control locations. Major drainages with regulatory closures include Big Beef Creek and the Union, Tahuya, and Dewatto Rivers.

- Several subareas appear to have sufficient data to make allocation decisions. In most subareas, additional data will probably be needed to resolve current water allocation issues and provide a basis for prudent water allocation decisions.



Where does the water come from?

Precipitation provides the sole source of water for all of the streams, lakes, springs, and other surface waters and ground water within the County. Some of this water evaporates or is used by plants, some flows into the streams and rivers, and the rest infiltrates into the soil to become ground water. Some segments of streams and rivers gain water from ground water that seeps into the channel. Other segments lose water that leaks through the streambed into the ground. The County has a characteristically marine climate typified by short, cool, dry summers, and prolonged, mild, wet winters. Winter storms generally approach the

County from the southwest. The southwestern portion of the County receives relatively high winter rainfall from storms which enter the area through a topographic gap between the Olympic Mountains and the Black Hills. The northern portion of the Kitsap Peninsula experiences drier winter weather because it is situated in the rain shadow of the Olympic Mountains.

Precipitation varies over the County from just under 30 inches/year in the north to almost 70 inches/year in the southwest. On a seasonal basis, 79 percent of the precipitation at the Bremerton Fire Station occurs in the six-month period from October through March. Additionally, total rainfall for the driest months of June, July, and August is seven percent of the annual total.

What are the major surface water sources?

Although surface water is not the primary source of supply, the County contains a multitude of creeks, only a few of which drain extensive land areas.

Surface water development in the County is primarily based on individual stream diversion rather than large dams with associated reservoirs. Casad Dam, located at McKenna Falls on the Union River, is the only major diversion structure in the entire County.

What are the major ground water sources?

Ground water is the dominant and most important source of supply in the County. Twenty-eight "principal aquifers" have been identified as an integral part of this assessment. The current level of knowledge and understanding for each aquifer varies considerably because of the complex hydrogeology of the area. A conceptual model and stratigraphic sequence of the 15 identified hydrogeologic units is presented in Chapter 5 of the assessment. Most of the aquifers are near or below sea level and are comprised of pre-Vashon geologic units. Perched aquifers occur throughout the County, making it difficult to distinguish aquifer characteristics and establish definitive boundaries. It is highly likely that additional, yet-to-be discovered, major aquifers exist within the County.

How are surface and ground water connected?

In areas where both surface water and ground water are used, the connections between the two sources become important. In some instances, ground water flows from the aquifer to the surface water, while in others, the reverse occurs. Ground water provides the base flow in the rivers and creeks which constitutes total flow during dry periods when there is no rain to contribute to the flow.

Hydraulic continuity refers to the interconnection between water bearing units, including ground water and surface water. Hydraulic continuity typically occurs where ground water discharges to surface water, such as in spring-fed lakes and gaining rivers; or where surface water discharges to ground water, such as from riverbed seepage to an adjacent alluvial aquifer. Where hydraulic continuity exists, changing hydraulic conditions in a ground water body will result in changes to connected surface water bodies.

How does land use affect water?

Land use practices can have profound effects on the amount and quality of water moving through the County.

From a regional viewpoint, the County contains abundant forestry areas and numerous government owned and operated facilities, including the Trident Submarine Base at Bangor, Keyport Naval Undersea Warfare Center, Puget Sound Naval Shipyard, Department of Defense Supply Center, and the Manchester Fuel Depot.

Outside of the urbanized centers of Bremerton, Port Orchard, Silverdale, Poulsbo, Kingston, and Bainbridge Island, the County is generally characterized by scattered, small communities, homes on acreage, and large parcels of undeveloped land. Low density, single-family dwellings and small farms are scattered throughout the County, and there are large areas of pasture and forest land.

Satellite imagery data show approximately 10 percent of the County in a developed state. The remaining area is largely coniferous forest (50 percent), other natural cover (35 percent), or mixed forest land (5 percent).

An analysis of land use codes utilized by the County Assessor shows a similar pattern with about 75 percent open, forested, or rural, and another 10 percent classified as suburban. According to the Assessor's data, about 14 percent of the area is classified as urban, commercial, or industrial.

Although nearly 90 percent is rural and forested, the County is ranked second only to King County in overall population density, with 562 persons per square mile in 1995.

The County ranks sixth in total population (220,600 in 1995) and has experienced a 31 percent increase in population since 1985, ranking eighth in growth in the State.

The highest growth is projected for the Manette, Gorst, and Manchester subareas. Lowest population growth is predicted for the Stavis, Tahuya, Anderson, and Dewatto subareas.

What are the water quality issues?

Ground water throughout the County is generally of good quality and suitable for most purposes. With only a few exceptions, water sampled from over 1,100 wells located throughout the County was within State drinking water standards. Aesthetic standards for iron and manganese were frequently exceeded, as is typical for glacial aquifers of Western Washington. Ground water quality testing associated with sites of known contamination (such as landfills, the three major military installations, and the Wycoff Wood Preservation Facility) indicates only local perched aquifers have been affected so far.

Time series evaluation of water quality data was performed as part of the Kitsap County Ground Water Management Plan (GWMP) in 1991. The analysis employed water quality data provided by the EPA (including data from the USGS and from Group A wells), by Ecology (Group A), by the Washington Department of Health (Group A and B wells), and by the Bremerton Kitsap County Health District. Data collected at known ground water contamination sites were not included in these trend analyses. In general, the time series evaluations indicated no significant trends.

Are fish resources stable?

Escapements in many creeks in the County are generally not documented. Chum salmon returning during late November through December are considered healthy in the Hood Canal. Early-arriving chum salmon are considered depressed. Escapements in this region have ranged from 500 to 8,000 fish. Other salmon species are less abundant in County creeks.

The status of salmonid populations in the County is a concern to all agencies and organizations involved in water resources. Because of the poor returns of coho and chinook salmon to Hood Canal, there have been restrictions placed on harvesting these stocks.

A major factor in the decline of coho salmon stocks has been the reduced summer and fall flows in small streams associated with drought cycles. Some small streams have become unable to support coho production similar to the levels supported prior to 1975. For example, the average annual rainfall for Seabeck over the last 16 years (55.93) has been four inches less than the long-term average of 59.92 inches.

Fish habitat quality is greatly reduced by nonpoint pollution. Storm water runoff from construction sites, roadways, and cleared land continues to cause both erosion and siltation of streams removing critical juvenile rearing habitat. Other factors affecting the survival of all salmonid species are the influence of hatchery fish on natural spawning stocks and the interception of fish returning to the Kitsap Peninsula. The impact of harvest on returning adults was well demonstrated by the fishing closure in 1994 and the subsequent, significant increase in coho adults spawning in the streams of Hood Canal in the fall and winter of 1994/95.

Existing fisheries habitat information for much of the County is limited and does not provide a sufficient basis for an in-depth assessment.

How have streamflows and water levels changed?

The ability to conduct annual streamflow trend analyses throughout the County is also severely limited. Data records are short, available only for isolated periods, and/or available only prior to the rapid water resource development which began in the early 1970s. Long-term data records (those over 25 years) are best suited to streamflow trend analysis.

Several different techniques were used to assess trends in minimum streamflows (summer low flows). The minimum flow analyses were limited by available data.

Comparison of regulatory instream flow requirements and historic flow curves for a few rivers and creeks showed that current instream flow requirements were not satisfied to varying degrees throughout the year.

It should be noted that in establishing instream flows by regulation, Ecology recognizes that the recommended regulatory flows are not, and probably have never been met, 100 percent of the time. The intent of the regulation, however, is to protect streams from further depletion (for instance, through subsequent appropriations) when flows approach or fall below the recommended discharges.

Water level trend analysis was accomplished utilizing data from a subset of the wells in the GWMP monitoring network. Hydrographs for 149 wells were developed. An exhaustive review of in-well and regional production data has not been conducted.

What are water rights?

The State of Washington manages ground water and surface water withdrawals through a system of permits. Water withdrawals for all but limited small ground water uses must be authorized by Ecology. Upon receiving an application for a water right, Ecology conducts an extensive evaluation, which is

currently taking in excess of five years, to determine whether or not they should issue a permit to develop the water resource. Water right certificates are issued after the water appropriation has been perfected (actually put to beneficial use). Water rights established through the permit system have been recognized by existing water laws since 1917 for surface water and 1945 for ground water.

A water right is a legal authorization to use a certain amount of public water for specific beneficial purposes. State law requires every user of streams, lakes, springs, and other surface waters to obtain a water right permit before using these waters. People who use ground water also need a water right permit unless they use 5,000 gallons or less each day for one or more of the following purposes: watering stock, watering a lawn or garden less than one-half acre in size, or a single, group domestic, or industrial water supply.

Three categories of water rights, although recognized, can not be quantified as a part of this assessment. The first category relates to ground water withdrawals in small quantities (i.e., exempt from permit requirements pursuant to RCW 90.44.050). The second and third categories relate to federal reserved rights associated with either US Reservations (e.g., military) or Indian Reservations.

What are water right claims?

Not all uses of water developed before 1917 for surface water and 1945 for ground water were registered as part of the water rights process. To preserve active water withdrawals developed prior to these two dates, the State required individuals to register withdrawals during a "claims period" between 1969 and 1974.

A water right claim is not an authorization to use water, but rather a statement of claim to a water withdrawal generally developed prior to 1917 or 1945. In most cases, the validity of existing claims has not been determined.

A water right claim is just a claim for a right to use water. A water right claim on file with Ecology may or may not represent a valid water right. The validity of a claim cannot be determined until the court rules on it through an adjudication process.

Why are water rights important?

The basis for water rights is "first in time, first in right." This means people with older, or senior, rights get to use the water first when there is not enough for everyone. The water rights program ensures that Washington's water resources are appropriately allocated and managed. By effectively managing the allocation of new water rights, senior water rights can be protected.

Exhibit 2
Historic Growth of Water Allocations

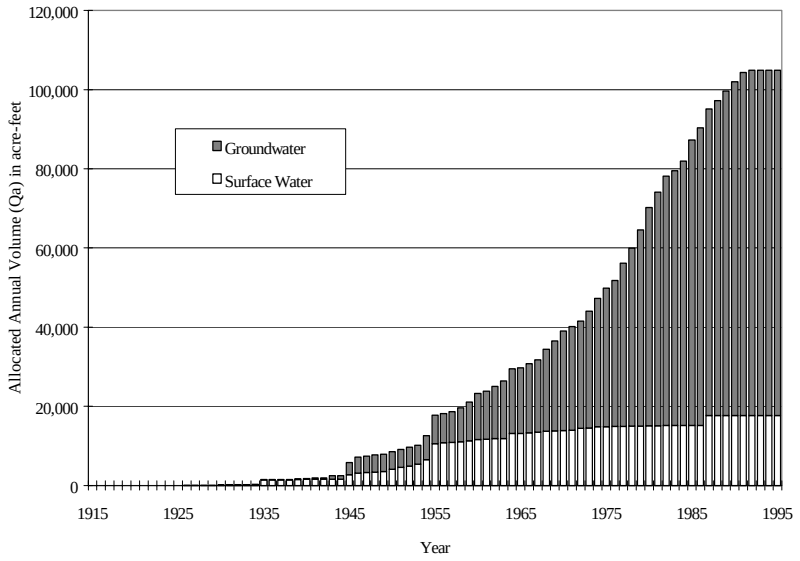


Exhibit 2 shows the historic growth of water rights and annual allocations over the past 80 years throughout the County. This graph dramatically illustrates the rapid pace of increased water resource development that occurred in the 1970s and 1980s. It also shows that since 1990 very few ground water right allocations were made.

How is water currently allocated and what new uses are proposed?

Exhibit 3 displays the total allocation, claims, and uses of ground and surface water rights.

Currently, ground water withdrawals dominate water rights (and to a lesser extent, water right claims). Ground water rights represent 83 percent of current total allocations, and ground water claims account for 71 percent of current total claims. Issued water rights exceed water right claims for both ground water and surface water.

Ground water resources are also primarily allocated for domestic multiple (57 percent) and municipal (31 percent) use. Fish propagation comprises eight

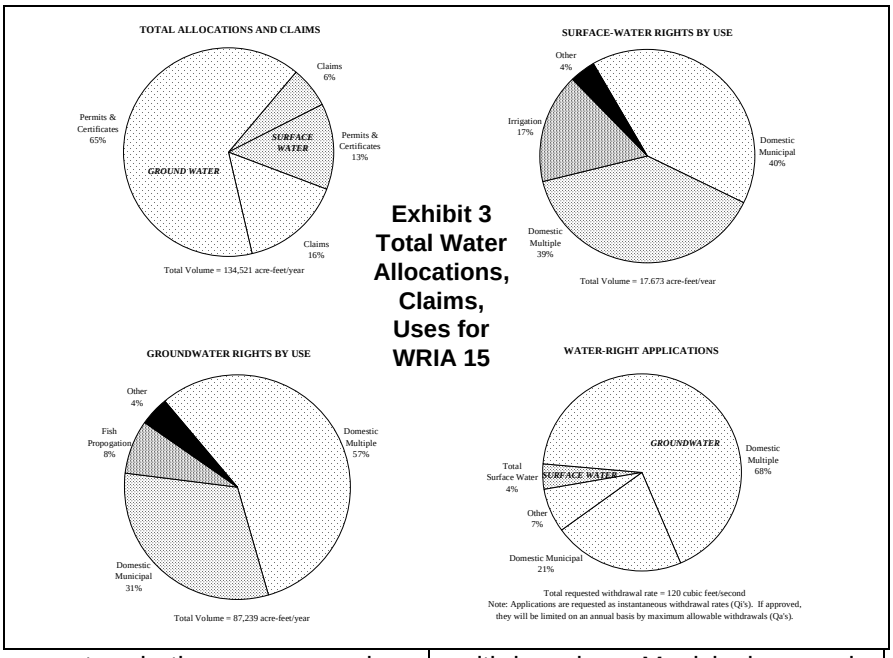


Exhibit 3 Total Water Allocations, Claims, Uses for WRIA 15

percent and other uses comprise the remaining four percent.

Water resources associated with water right claims appear to be primarily associated with irrigation. Based on the irrigated acreages and the formulas for water-duty assignments, at least 49 percent of the surface water claims and 91 percent of the ground water claims can be attributed to irrigation.

Surface water resources are primarily allocated for municipal (40 percent) and domestic multiple (39 percent) use. Irrigation uses comprise 17 percent and other uses comprise the remaining four percent.

There are 220 pending applications for new water rights within the County on file with Ecology.

Applications for ground water rights comprise the majority of potential future water allocations. Presently, 200 ground water applications exist for 41,530 gpm (92.5 cfs) and 20 surface water applications exist for 3.6 cfs. Exhibit 3 also shows the distribution of these applications. The majority of the total quantity requested (68 percent) is for domestic multiple ground water withdrawals. Municipal ground water withdrawals account for 21 percent of the total quantity requested, and other ground water withdrawals account for seven percent. Surface water applications account for only four percent of the total quantity. The current total surface water request is primarily divided between irrigation (31 percent), municipal (27 percent), domestic multiple (23 percent), and fish propagation (17 percent) uses.

What are the conflicts in the County?

Water use conflicts occur when available water supply is unable to satisfy existing water rights, claims, new appropriations, and, at the same time, maintain sufficient water quality as well as aquatic habitat.

Balancing these competing needs is complex. For example, where recommended instream flows are not met more than 50 percent of the time during the lowest flow periods in late summer and early fall, additional water allocations may not be available from shallower aquifers during these months.

Comprehensive, long-term streamflow data are lacking in most areas of the County. Therefore, it is difficult to quantify and evaluate water availability from contributing aquifers.

The interconnection between surface and ground water and the effect of ground water withdrawals on streamflows in much of the County is not well known or understood. In areas draining to streams, administratively closed to protect habitat, or that have recommended flow limitations, the interconnection between ground and surface water will have to be evaluated when deciding on new allocations. Monitoring for seawater intrusion should be continued and expanded.

An analysis of land use, population projections, and water demand indicates that the County will have significant urban growth in some subareas (Manette, Gorst, Manchester), while other subareas will remain rural with relatively low growth (Anderson, Dewatto, Stavis, and Tahuya).

New water rights will need to be granted for existing public water systems. For the most part, these do not appear to be large increases over existing rights (certificates). Much of the forecasted demand may be covered under existing water right applications.

Identifying areas where additional water rights will be required is key to effectively prioritizing studies to support water right allocation decisions in the County. Future assessment efforts should focus first on subareas such as Bainbridge, Kingston, and Manchester. These subareas will be accommodating significant population growth and will require improved data and better information on which to base water allocation decisions.

A summary of average day water demand for the County developed for the GWMP is displayed on Exhibit 4. The water demand uses include municipal and domestic, commercial/industrial, irrigation, fish propagation, and stock watering. Instream uses are not included.

The total average day water resource requirement was about 31 MGD in 1990. It is projected to increase to approximately 45 MGD by 2020. This assumes water consumption habits and lifestyles will not change. If an increase in multi-family housing units occurs in the urban areas of the County, and a municipal and domestic water conservation program is initiated, then the average day demand in 2020 is projected to be about 39 MGD. An additional water resource requirement of 8 to 13 MGD (8,961 to 14,600 acre feet per year) over 1990 average day supply will be needed by 2020.

Total peak day demand was approximately 74 MGD in 1990. By 2020, peak day demand is anticipated to reach almost 100 MGD. The additional water resource requirement for a peak day in 2020 would be approximately 26 MGD over the 30-year forecast period.

Recent population growth has exceeded projections used by the GWMP so these demand projections are probably low.

What are the water balance components?

A water balance is an assessment of the major components of a hydrologic system and includes the interactions between surface water and ground water systems.

The components of a simplified water balance equation can be expressed as:

Precipitation=Evapotranspiration+ Runoff+Recharge

Exhibit 5 summarizes the estimates of water balance components for Kitsap County.

Where do we go from here?

Finally, Exhibit 6, provides a summary for each of the 18 subareas within Kitsap County.

Several factors can be considered in making water right decisions. They include: potential for stream-aquifer continuity, potential for seawater intrusion, degree of water resource allocation, ground water level trends, streamflow trends, and the impact on fish due to changes in habit and water quality.

This Initial Basin Assessment does not provide a complete picture of water resources in Kitsap County. It acknowledges that additional data collection and more in-depth analysis of information will be required to make some future water right decisions.

Ecology wants to hear your opinions and ideas on these and other water allocation issues and proposed actions. Usually, a combination of actions is required to effectively manage water resources and meet the challenges and opportunities facing all of the stakeholders involved.

While mandated by law to protect instream water use and existing water rights, Ecology also is responsible for making decisions on applications for new water rights. The public's opinion is important to Ecology in making program decisions governing water use. Ecology invites public input on future steps to be taken. Ecology will also work with people who have applied for new water rights and discuss options for processing their applications.

What additional information is available?

If you would like to learn more about water issues in the Kitsap County Basin, the following are some of the studies and technical reports that are available:

Dion, N.P., Olsen, T.D., and Payne, K.L. 1988, Preliminary Evaluation of the Ground Water Resources of Bainbridge Island, Kitsap County, Washington, US Geological Survey Water

Exhibit 4

1990-2020 Average Day Water Demand

Average Day Water Demand Uses	1990 *MGD	1990 Percent	2020 *MGD	2020 Percent
Municipal	19.55	63%	30.43	68%
Domestic/Single Family	4.89	16%	7.61	17%
Commercial/ Industrial	0.27	1%	0.27	1%
Irrigation	1.18	4%	1.18	3%
Fish Propagation	5.20	17%	5.20	12%
Stock Watering	0.04	0%	0.04	0%
TOTALS:	31.13	100%	44.73	100%

*Note: MGD = Million Gallons Per Day

Source: **Volume 1 GWMP, 1991, Table II-9, pg. II-67**

Resources Investigations Report 87-4237.

Becker, J.E., 1995, Hydrogeological Analysis of the Bangor Aquifer System, Kitsap County, Washington.

Ecology, Department of, 1981, Chapter 173-515 WAC, Instream Resources Protection Program Kitsap Water Resource Inventory Area (WRIA) 15.

Economic and Engineering Services, Inc. (EES), November 3, 1992, Kitsap County Coordinated Water System Plan Regional Supplement (CWSP).

Garling, M.E., Molenaar, D.E. and others, 1965, Water Resources and Geology of the Kitsap Peninsula and Certain Adjacent Islands: Washington State Division of Water Resources, Water Supply Bulletin No. 18, 309 p., 5 plates.

Hansen, A.J., and Bolke, E.L., 1980, Ground Water Availability on the Kitsap Peninsula, Washington: US Geological Survey Water Resources Investigations Open File Report 80-1186.

Kitsap County Phase I Basin Assessment Reference File

Kitsap GWAC et al., 1991, Kitsap County Ground Water Management Plan, Background Data Collection and Management Issues, Volume I and II.

Lestelle, L.C., and others, December 1993, Evaluation of Natural Stock Improvement Measures for Hood Canal Coho Salmon: Point No Point Treaty Council, Technical Report TR 93-1, 173 p.

Robinson and Noble, Inc., November 1992, Investigation of Impacts on Dogfish Creek from the Use of the City of Poulsbo's Pugh Road Well.

Sceva, J.E., 1957, Geology and Ground Water Resources of Kitsap County, Washington, US Geological Survey Water Supply Paper 1413.

Williams, R.W., R.M. Laramie, J.J. Adams, 1975, A Catalog of Washington Streams and Salmon Utilization, Vol. 1, Puget Sound Region, Washington Department of Fisheries, Olympia, WA.

AGI Technologies, November 18, 1996, North Perry Avenue Water District Wellhead Protection Investigation. Report prepared for North Perry Avenue Water District, Bremerton, WA.

AGI Technologies, October 8, 1996, Final Report Gorst Creek Basin Study Phase I. Report prepared for City of Bremerton Public Works, Bremerton, WA.

For more information... Contact Raymond Hellwig at (206) 649-7096 (voice), (206) 649-4259 (TDD), or write to the Department of Ecology, 3190-160th Ave. SE, Bellevue, Washington 98008-5452. Ecology does not discriminate in its services. If you have special communications needs, contact Lisa Newman at (360) 407-6604 (voice) or (360) 407-6006 (TDD).

Exhibit 5
Conceptual Hydrologic Cycle for Kitsap County

Precipitation (PPT)

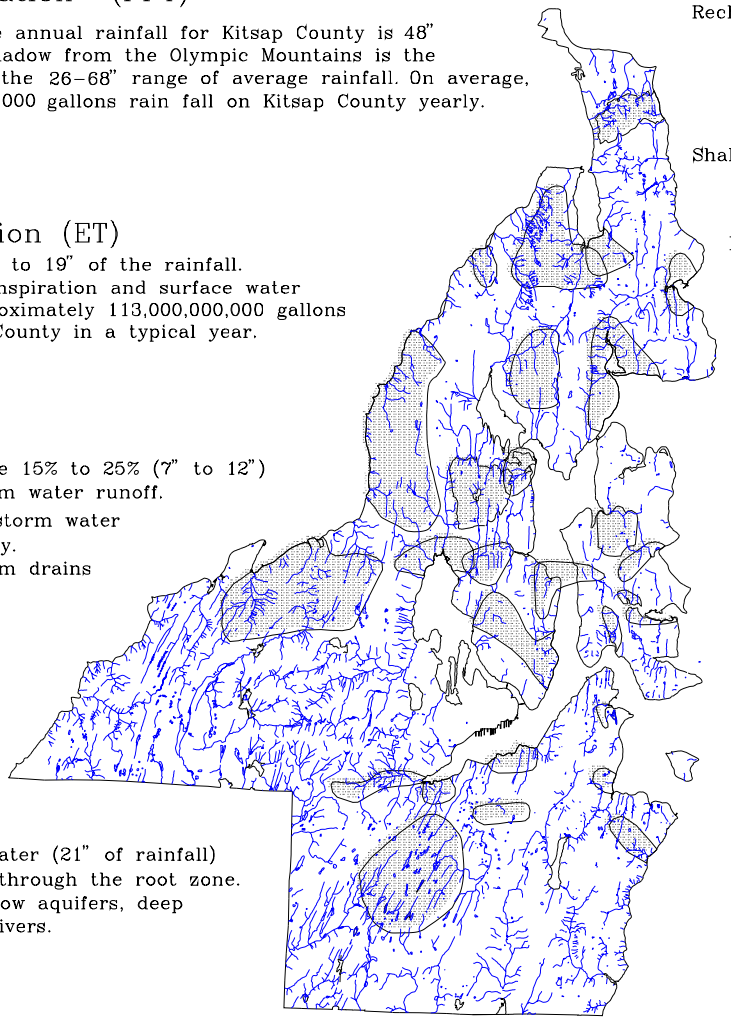
The average annual rainfall for Kitsap County is 48"
The rain shadow from the Olympic Mountains is the reason for the 26–68" range of average rainfall. On average, 316,000,000,000 gallons rain fall on Kitsap County yearly.

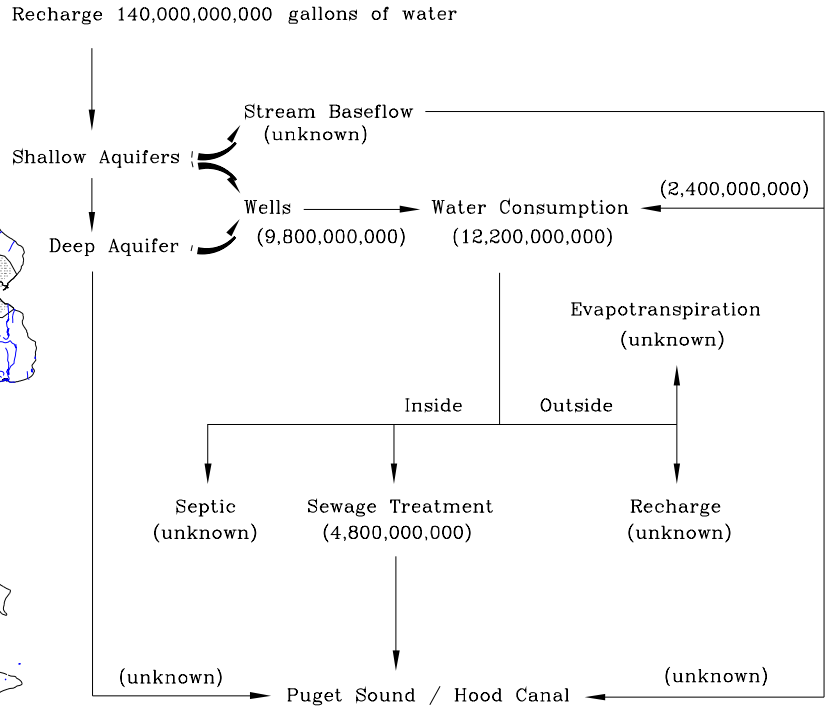
Evapotranspiration (ET)

The range of ET is 14" to 19" of the rainfall.
Between vegetation transpiration and surface water body evaporation, approximately 113,000,000,000 gallons of water leave Kitsap County in a typical year.

Storm Water Runoff

Studies in the Puget Sound Area indicate 15% to 25% (7" to 12") of rainfall passes quickly to sea as storm water runoff.
Approximately 63,000,000,000 gallons of storm water runs off the County's land mass annually.
The split in storm water runoff via storm drains verses streams is unknown.





Recharge

Approximately 140,000,000,000 gallons of water (21" of rainfall) annually inflitrates in the soil and passes through the root zone. This provides the source of water for shallow aquifers, deep aquifers, and base flows for streams and rivers.

Water Consumption

1995 Consumption is estimated at 12,200,000,000 gallons
2020 Consumption is projected at 15,000,000,000 gallons

EXHIBIT 6
Kitsap County Initial Basin Assessment Summary

Kitsap County Basin Subarea	Area Square Miles	Dominant Land Use Population Density: Area Pattern	Dominant Land Use Population Density: 1990 Density	Projected Annual Growth Rate	Known Water Quality Threats	Established Year-Round Stream Closures	Subarea Stream-Aquifer *Continuity Probability	Relative Seawater Intrusion Potential	Average Rainfall	Water Resource **Relative Development	Pending Water Development Applications (Max. Withdrawal)	Percent of Total Inflow
Hansville	16.5	Rural	160	2.5%	Minimal	Little Boston Creek	**RH**-Hansville Aquifer **RL**-Sea Level Aquifer	**No** Hansville Aquifer **Yes** Sea Level Aquifer	30	8%	Ground Water = 301 gpm Surface Water = 0	3%
Kingston	30.7	Rural Suburban	295	3.3%	Minimal	Grovers Creek (Seasonal) Thompson Creek Cowling Creek and Smaller Streams	**RL**-Kingston Aquifer Port Gamble South **RH**-Suquamish - Miller Bay Aquifer	**Yes** If Excessive Ground Water Development Occurs	34	24%	Ground Water = 3030 gpm Surface Water = 0.5 cfs	17%
Port Gamble	19.1	Rural	220	4.2%	Negligible	Gamble Creek	**RH**-Edgewater Aquifer RH-Port Gamble Aquifer	**Yes** Edgewater and Port Gamble Aquifers	36	11%	Ground Water = 3355 gpm Surface Water = 0.1 cfs	26%
Poulsbo	18.7	Suburban Urban	450	3.7%	Minimal	Dogfish Creek and Johnson Creek	**RL**-Poulsbo Aquifer **RH**-Other Perched Aquifer	**Yes** If Excessive Ground Water Development in Coastal Area	37	19%	Ground Water = 2792 gpm Surface Water = 0	20%
Bangor	35.7	Commercial Rural Urban	636	2.2%	Past Land Use Contam-inated Sites	Strawberry Creek Barker Clear Creek, and Scandia Creek	**RH**-Island Lake Aquifer Varies Between Four Aquifer Systems	Varies Between Four Aquifer Systems	41	23%	Ground Water = 8142 gpm Surface Water = 0	28%
Bainbridge Island	29.1	Suburban Surban Rural	540	2.6%	Urban Develop-ment. Otherwise Minimal	Two Small Unnamed Stream Tributary to Murdan Cove Fletcher Bay	**RH**-Meadowmeer Aquifer Varies Between Six Aquifers, But RL	**No** - Meadowmeer Aquifer; Varies Between Six Aquifers Depending Upon Ground Water Development	35	30%	Ground Water = 3384 gpm Surface Water = 0.97 cfs	22%
Manette	17.7	Urban Commercial	2,000	3.2%	Urban and Commercial Develop-ment	Steel and Mosher Creeks	Varies Between Three Aquifers, but RL	Bucklin Hill Aquifer Minimal. Varies Between Three Aquifer Systems	40	43%	Ground Water = 2803 gpm Surface Water = 0.97 cfs	23%
Chico	19.7	Rural Commercial	480	2.5%	Urban/ Suburan	Chico/Kitsap Creeks. Unnamed Kitsap Lake Tributary	Aquifers Not Well Understood; Potential Continuity Unknown	Not Well Understood; Possible Coastal Area If Excessive Ground Water Developed	53	7%	Ground Water = 296 gpm Surface Water = 0	1%
Seabeck	27.3	Rural	130	1.2%	Minimal	Big Beef Anderson and Seabeck Creeks	Varies Between the Three Aquifers; RL Except Perched Aquifer	Varies Between Three Aqufiers; Not Possible Perched Aquifers	57	10%	Ground Water = 2524 gpm Surface Water = 0	7%
Stavis	10.2	Rural	75	1.1%	Minimal	None	Not Understood. RH for Perched Aquifers	No Major Aquifer Identified. Not Possible Perched Aqufiers	64	3%	Ground Water = 165 gpm Surface Water = 0	1%
Manchester	45	Rural Urban	660	2.5%	Urban Land Develop-ment	Curley (seasonal) Blackjack, Sullivan, Beaver, Salmonberry Creeks	Varies Between Six Aquifers. RH for Wilson and North Lake Aquifers	Varies Between Six Aqufiers. Possible in Port Orchard/Yukon Aqufiers if Excessive Supply Developed	43	24%	Ground Water = 7831 gpm Surface Water = 0.91 cfs	20%
Gorst	23.5	Industrial Urban Commercial	1,150	3.2%	Urban Suburban Commercial Lt. Industry	Anderson and Ross Creeks Union River,	Varies Between Two Aquifers	If Excessive Ground Water Supply Developed	51	18%	Ground Water =1470 gpm Surface Water = 0	6%
Union	16.5	Rural	52	2.5%	Minimal	Mission Lake, and Little Mission Creek	No Major Aquifer Identified. RH for Perched Aqufiers; Not Understood	Not Possible Perched Aqufiers. Little Potential Exists	58	15%	Ground Water =564 gpm Surface Water = 0	3%
Tahuya	14	Rural	57	1.1%	Minimal	Tahuya River	Not Understood. RH For Perched Aquifers	Not Possible Perched Aquifers. Little Potential	62	1%	Ground Water =642 gpm Surface Water = 0	3%
Anderson	8.3	Rural	12	1.1%	Minimal	Harding Creek	Not Understood. RH for Perched Aquifers	Not Possible Perched Aquifers. Not Understood	66	<1%	Ground Water = 0 gpm Surface Water = 0	0%
Olalla	25.4	Rural Suburban	340	3.9%	Strandley Scrap Metal; Olalla Landfill	Purdy and Burley Creek	Not Understood. RH for Perched Aquifers	Not Possible Perched Aquifers. Not Understood	44	11%	Ground Water = 1651 gpm Surface Water = 0	7%
McCormick	33	Rural	120	2.2%	Land Use Patterns Minimal	Minter Creek	Not Understood. RH for North Lake Aquifer and Other Perched Aquifers	Not Possible Perched Aquifers. Low Potential	52	2%	Ground Water = 2080 gpm Surface Water = 0	5%
DeWatto	6.4	Rural	21	1.1%	Minimal	DeWatto River	Not Understood. RH for Perched Aquifers	Not Possible Perched Aquifers. Not Understood	66	<1%	Ground Water = 0 gpm Surface Water = 0.1 cfs	0%

*__Continuity__ Abbreviations RH - Relatively High RL - Relatively Low
**__Relative Development__ is percent of total inflow (Precipitation minus Evapotranspiration) to the subarea that has already been allocated.