Washington State
Water Quality Assessment

Year 2002 Section 305(b) Report

June 2002

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Year 2002 Section 305(b) Report

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Abstract

This report serves to fulfill the water quality assessment reporting requirements of federal Clean Water Act Section 305(b) for the year 2002. The water quality assessment was conducted according to published guidance from the U.S. Environmental Protection Agency. The assessment was conducted statewide using a sample survey approach. The sample survey approach allowed the estimation of the condition of 98% of streams and 100% of estuaries in Washington State. The assessment was conducted with data collected from stations in both the Washington State Department of Ecology routine ambient monitoring program and the Environmental Monitoring and Assessment Program. Stream stations were stratified into subpopulations according to size and ecoregion. Stations from estuary areas were stratified into three subpopulations based on morphology. Assessments were made of the support of specific uses designated for protection in the Washington State Water Quality Standards by the criteria identified. Statewide water quality conditions were estimated and the precision of the estimate provided. Results show that designated uses were fully supported in 47% of all streams and 58% of estuaries assessed statewide.

Introduction

The federal Clean Water Act establishes a process for states in developing information on the quality of its surface waters. Section 305(b) of the statute requires that each state periodically prepare a water quality assessment report. The U.S Environmental Protection Agency (EPA) compiles the information in the state reports, summarizes them, and transmits the summaries to Congress along with an analysis of the status of water quality nationwide. This report serves to provide the water quality assessment for Washington State required under Section 305(b) for the year 2002.

The assessment was conducted based on published guidance on preparing the report (EPA,1997). This report presents an assessment of the support of uses designated for protection in Washington State's Water Quality Standards Chapter 173-201A Washington Administrative Code). The report also presents an assessment of the causes of use impairment. Management program descriptions have been previously presented in Washington's Section 305(b) Report for the year 2000 (Beckett, 2000). An assessment of the possible pollution sources causing use impairments will be submitted to EPA as part of the "Integrated Report" (Wayland, 2001) expected in 2003.

EPA (1997) guidance requests States to provide a comprehensive assessment of all surface waters in the state. It is simply not possible to monitor the quality of all waters statewide using a "census" approach (e.g., monitoring every surface water). To conduct a comprehensive statewide assessment, EPA recommends using a "sample survey" approach. A sample survey approach allows for the estimation of the conditions of waters statewide by making inferences from a defined set of monitoring locations. The level of certainty for these estimates can be described.

Sample surveys are intended to produce assessments of the condition of the entire resource when that resource cannot be subject to a complete census. Sample surveys rely on the selection of monitoring sites that are representative of the resource. EPA (1997) describes two different sample survey designs: probability-based and judgmental. Both designs use a stratified sampling method so that inferences can be made about other waters that the samples represent, with a known level of certainty. These two types of monitoring designs are described below.

The *probability-based design* uses monitoring stations that are selected in a statistically random method. Randomization in the site selection process is the way to assure that sites are selected without bias. This approach is used to select stations for EPA's Environmental Monitoring and Assessment Program (EMAP).

The random selection of stations provides that:

- Every possible station (population) has a known probability of being selected for monitoring (sample).
- The set of stations monitored (sample) is drawn by some method of random selection, or a systematic selection with a random start.
- Estimates are made about the population from the sample.

The EMAP design uses a tiered grid approach for selection of stations and estimating probabilities. The sampling approach attempts to measure not only population variance, but also variance caused temporally or by the assessment indices. This type of design requires a large sampling network and a long-term commitment. However, use of a probability-based design has several drawbacks for use in the water quality assessment. The most significant is the need to establish a new sampling network based on random selection. With this design, one cannot use data collected by an existing sampling network. Also there are much higher costs associated with traveling to remote stations that may have limited access.

Judgmental design is the other sample survey approach recommended by EPA (1997). Selection of monitoring locations is based on the best professional judgment that the sites are representative of the target resource (i.e., a subpopulation of surface waters). The method assumes that the stations selected represent all waters in a particular subpopulation (e.g., stratum). Monitoring station locations from an existing sampling network are reviewed individually to determine the reasons why the location was selected. Data for the assessment is used from stations which were located because they represent a type of water within an area. Since they represent an inherent bias, data from stations that were located based on the identification of specific problems (e.g., downstream of a specific wastewater discharge) are not used in the water quality assessment.

The judgmental design has several advantages for use in the water quality assessment:

- All stations selected are accessible.
- Allows the making of estimates with a known precision and confidence.
- Data collected by existing sampling network can be used -- will not have to wait for new sampling data to conduct assessments.
- Assessments can be made for any surface water type (i.e., streams or estuaries).

However, there are some deficiencies in the judgmental design:

- Assumes that stations selected by judgment represent all waters in the stratum.
- Statewide estimates may still be biased due to factors unknown to the monitoring agency who selected stations using best professional judgment.

Based on an assessment of the advantages and deficiencies of each design, this water quality assessment uses a judgmental sample survey design for assessment of most designated uses. However, the assessment of wildlife habitat was conducted from data collected from monitoring stations selected using a probability-based design from the EMAP program.

Assessment Methods

Data from stations in both Ecology's routine ambient monitoring program and the Environmental Monitoring and Assessment Program (EMAP) were selected for use in this assessment. The stations from the routine ambient monitoring program were selected by best professional judgment to represent the characteristics of similar waters in the geographic area (judgmental design). The stations from EMAP were selected by a spatially-balanced, random approach (probability-based design). Data used in this assessment from the routine ambient monitoring program were collected statewide from streams and estuaries from 1993 to 2001. Data used in this assessment from EMAP were collected statewide from streams during 2000.

Ecology eliminated its statewide lake monitoring program in 1999. As such, no new assessment of the water quality of lakes was conducted. The last assessment of lake water quality in Washington's Section 305(b) Report for the year 2000 (Beckett, 2000) represents the most current data from lakes.

Selected stream stations were stratified into subpopulations according to size and ecoregion (Omernik and Gallant, 1987) to represent subpopulations of the target resource (Figure 1). Subpopulations with no representative stations were not assessed. Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. The following ecoregions were used to as subpopulations of streams.

- Coast Range
- Puget Lowlands
- Willamette Valley (Clark County Area)
- Cascades (includes the Olympic Mountains)
- East Cascades and Foothills
- Columbia Basin
- Northern Rockies (Pend Oreille County Area)
- Blue Mountains (Asotin County Area)

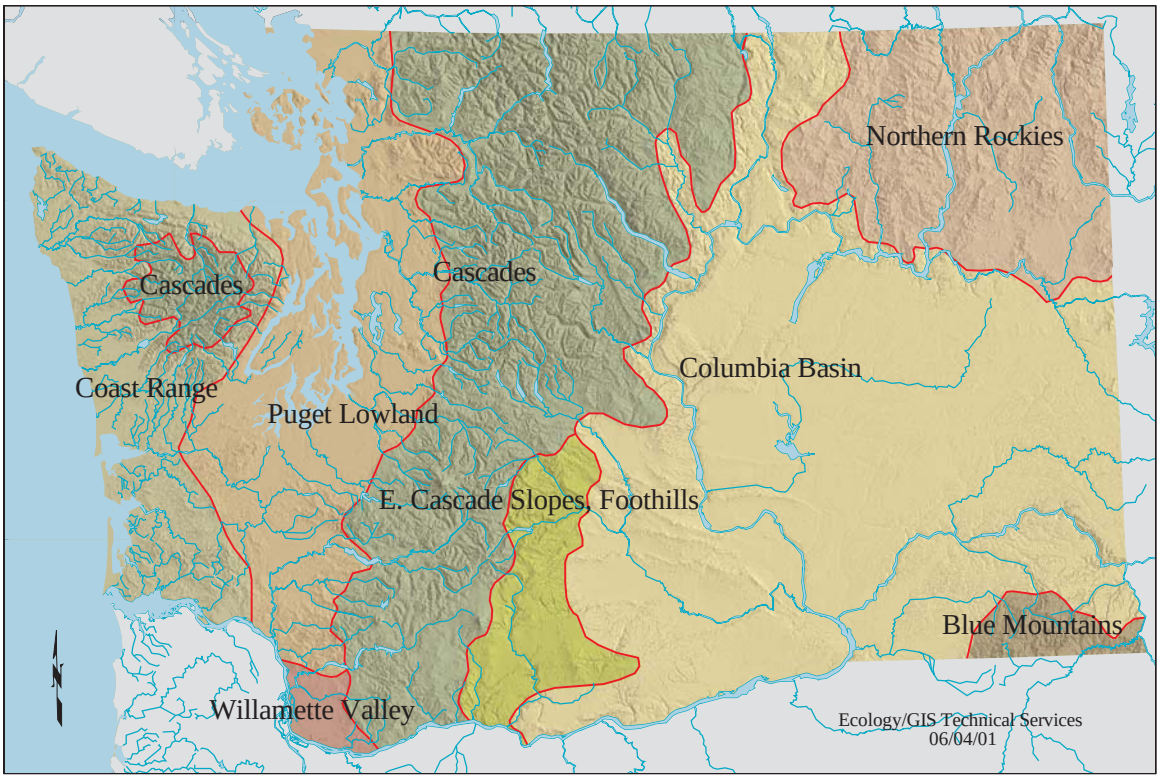

Figure 1. Washington State Ecoregions

Streams stations were also stratified by size into two subpopulations. "Large Streams" were defined as those reaches that are shown with double-banked cartographic features in the Washington Rivers Information System GIS coverage. "Small Streams" were defined as those reaches that are in the coverage as a single line.

Stations from estuary areas were stratified into three subpopulations: (1) Deep, well-mixed open water areas, (2) Somewhat protected channels and passages, and (3) Bays, inlets and harbors. Waters overlying shallower depths will be included in the stratum of water contiguous to it. For example, no separate stratum will be made for shallower shoreline areas adjacent to deep water with monitored stations.

The following specific uses designated for protection in the Washington State Water Quality Standards (Chapter 173-201A Washington Administrative Code) were assessed. No evaluation was made to determine if natural conditions caused indicators to exceed the criteria. As such, it is important to note that many of the impairments identified may be due to natural conditions.

Aquatic Life and Contact Recreation Uses

The data collected for indicators with numeric criteria in the water quality standards were used from each station to assess the support or impairment of specific designated uses. The indicators assessed were temperature, dissolved oxygen, pH, ammonia, fecal coliform, and metals (arsenic, cadmium, copper, lead, mercury, nickel, and zinc). The specific designated uses assessed were fish migration, fish spawning, salmonid spawning, shellfish spawning, shellfish harvesting, primary contact recreation, and secondary contact recreation. Other uses designated in the standards were not assessed due to the lack of specific numeric criteria.

EPA (1997) recommends using the specific frequency that data exceed numeric criteria to assess use support of aquatic life and recreational uses. If 25% or greater of the data exceed any one criterion, support of the specific use was considered "poor". If more than 11% but less than 25% of the data exceed the criterion, support of the specific use was assessed as "fair". If less than 10% of the data exceed the criterion, support of the use was considered "good".

EPA guidance requests that an overall “Aquatic Life “ use be reported, even though the specific use is not designated in state water quality standards. The overall “Aquatic Life” use support assessments were rolled up from assessments of the related individual designated uses classified in the standards. If one or more of the related individual uses assessed at a station are identified as fair or poor, the overall aquatic life use at the station were considered impaired. If all these uses assessed at a station are identified as good, then the overall aquatic life use at the station would be considered as good.

Wildlife Habitat Use

Habitat data collected by the EMAP program was used to assess the designated use of wildlife habitat. Wildlife habitat is defined in standards to include aquatic habitat. A riparian habitat quality index developed by EPA (Kaufmann et al. 1999) was used to assess support of the wildlife habitat use. The riparian habitat quality index combines several types of field measurements and observations of riparian vegetation and human disturbances collected by the EMAP program. The measures of riparian vegetation quality include a measure of stream bank canopy cover determined in the field with a densiometer and a measure of cover complexity and sustainability. The measure of riparian human disturbances taken from Kaufmann et al. (1999) is a proximity-weighted index of the extent and intensity of human activities within the channel, in the riparian zone, and in upland areas near the riparian zone. The index is calculated as the proximity-weighted sum of 11 categories of human disturbances, including buildings, roads, mining activities, lawns and parks, pastures and grazing, row crops, dams and bank revetments, influent and effluent pipes, trash and landfills, land clearing, and forest practices. The resulting integrated Riparian Condition Index (QR1) varies from 0 to 1. EPA has defined values less than 0.5 to be "poor", values between 0.5 to 0.63 to be "fair," and values greater than 0.63 as "good" riparian habitat.

Fish Consumption

The criteria from the National Toxics Rule (40 CFR 131) was used with metals data collected in streams in the routine ambient monitoring program to assess the fish consumption use. The criteria specified for a one-per-million carcinogenic risk to human health for the consumption of organisms only was used. If 25% or greater of the data exceed any one criterion, support of the fish consumption use was assessed as considered "poor". If more than 11% but less than 25% of the data exceed the criterion, support of the use was considered "fair". If less than 10% of the data exceed the criterion, support of the use was to be considered "good".

Overall Use Support

Following EPA (1997) guidance, individual use support assessments from each station were rolled up into an "Overall Use" support assessment in the same way as for the "Aquatic Life" use. If one or more of the related individual uses assessed at a station are identified as fair or poor, the overall aquatic life use at the station were considered impaired. If all these uses assessed at a station are identified as good, then the overall aquatic life use at the station would be considered as good.

The total size of each subpopulation was measured by intersecting the ecoregion coverage (Omernick and Gallant, 1997) with the Washington Rivers Information System coverage. Both GIS covers are at the 1:100K scale. Line features identified as centerlines to double banked features were defined as "Large Stream" reaches. Line features identified as streams and braided streams were identified as "Small Streams". The total size of each estuary subpopulation was taken from the boundaries previously delineated and assigned by best professional judgment (Butkus, 1997).

Statewide and subpopulation estimates of water quality conditions were inferred by use of the proportion of stations assessed for each subpopulation. The distribution of these proportions was then applied to the total size of the subpopulation derived from the GIS analysis. Assessments of the support of each designated use were estimated by both subpopulation and statewide. Assessment of the causes of use impairments were also estimated in the same way. The precision of the estimates for each subpopulation was made using 90% confidence limits for the sample proportion. The precision was determined using the following formula from Cochran (1987):

$$\text{Precision} = 1.645 * [\ p*(1-p)/n\ ]^{1/2}$$

Where **p** is the proportion of the estimate and **n** is the sample size.

Results

The statewide water quality assessment was conducted for over 70,000 miles of streams representing 98% of the total streams in Washington (Tables A1 & A3). The remaining 2% of streams not assessed were from subpopulations where samples were not collected (e.g., subpopulations in the Willamette Valley and Blue Mountain ecoregions). The assessment was also conducted for over 2900 square miles of estuary areas representing 100% of the estuaries in Washington (Table 2 & A4). No assessment of lakes or open ocean areas in Washington was conducted due to the lack of a monitoring program.

Overall, the designated uses were fully supported in 47% of all streams and 58% of estuaries assessed statewide (Tables A5 & A14). Use impairments were most prevalent on small streams and estuarine bays, inlets, and harbors (Figure 2). The Columbia Basin and the Puget Lowland Ecoregions show the highest rate of impaired uses (Figure 3). Aquatic life uses were mostly supported in streams (86%), but uses were impaired for most estuaries (71%) (Tables A6 and A14). Swimming was supported in a high percentage of streams (57%) and estuaries (98%) (Tables A12 and A20). Fecal coliform indicates the most impairment of uses in streams (Table 33) and dissolved oxygen indicates the most impairment of uses in estuaries (Table 34).

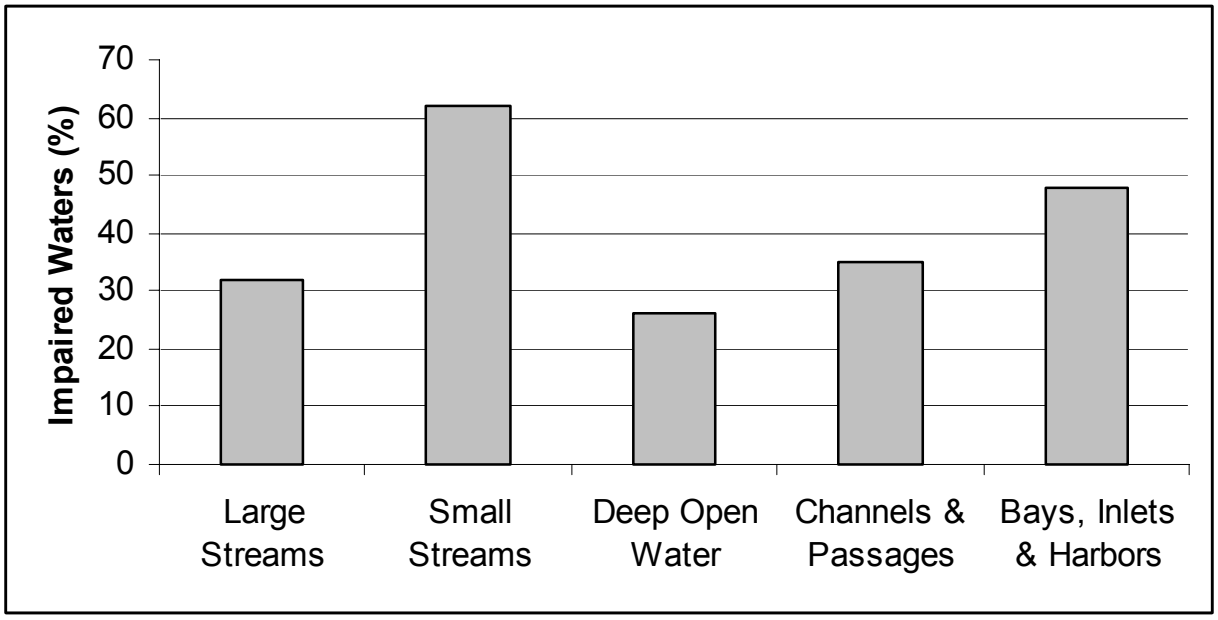

Figure 2. Overall Use Impairment Assessed in Morphometric Subpopulations

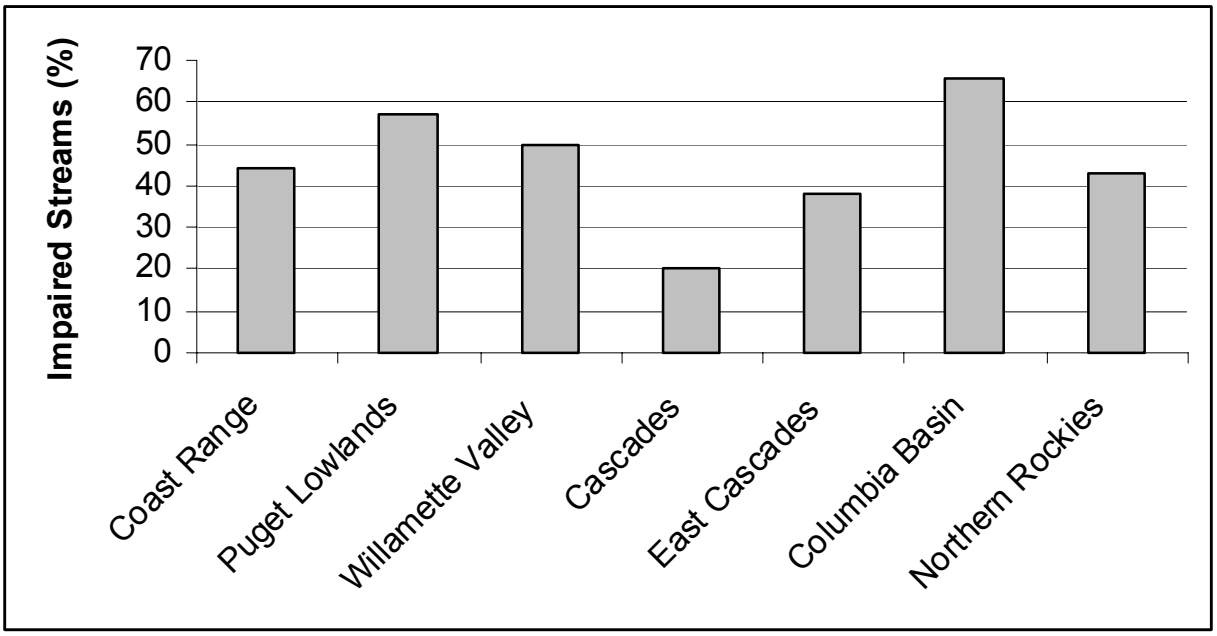

Figure 3. Overall Use Impairment Assessed for Streams in Ecoregions

Conclusions

- Designated uses were fully supported in 47% of all streams and 58% of estuaries assessed statewide.
- All aquatic life uses were fully supported in 86% of all streams and 28% of estuaries assessed statewide.
- Swimming was assessed as fully supported in 57% of all stream and 98% of estuaries statewide.
- The primary indicator of use impairment in streams is fecal coliform.
- The primary indicator of use impairment in estuaries is dissolved oxygen.
- Some of the impairments identified are likely caused by natural sources, such as the low dissolved oxygen in marine areas caused by upwelling of deep water.

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Tables

Table 1. Size of Streams Assessed by Designated Use and Type

Ecoregion	Stream Type	Size (miles)	Number of Stations Assessed
Coast Range	Large	6,122.15	9
	Small	252.10	9
	Total	6,374.25	18
Puget Lowlands	Large	7,553.30	17
	Small	397.53	81
	Total	7,950.83	98
Willamette Valley	Large	568.42	0
	Small	112.50	4
	Total	680.92	4
Cascades	Large	17,481.64	7
	Small	289.28	13
	Total	17,770.92	20
East Cascades and Foothills	Large	3,222.28	3
	Small	26.35	5
	Total	3,248.63	8
Columbia Basin	Large	24,401.20	24
	Small	944.11	38
	Total	25,345.31	62
Northern Rockies	Large	7,680.59	5
	Small	215.59	18
	Total	7,896.18	23
Blue Mountains	Large	1,122.84	1
	Small	49.55	0
	Total	1,172.39	1
Statewide	Large	68,152.42	66
	Small	2,287.01	168
	Overall Total	70,439.43	234

Table 2. Size of Estuaries Assessed by Designated Use and Type

Estuary Type	Size (square miles)	Number of Stations Assessed
Deep, Well-mixed Open Water Areas	1,886.76	8
Somewhat Protected Channels and Passages	541.64	20
Bays, Inlets, and Harbors	475.46	45
Total of All Types	2,903.86	73

Table 3. Percent of Streams Assessed by Designated Use and Type

	Stream Type		
Designated Use	Large	Small	All Types
Aquatic Life	98%	95%	98%
Fish Migration	98%	95%	98%
Fish Spawning	98%	95%	98%
Salmon Spawning	98%	95%	98%
Primary Contact Recreation	98%	95%	98%
Secondary Contact Recreation	98%	95%	98%
Fish Consumption	58%	82%	59%
Wildlife Habitat	0%	62%	60%
Overall Use	98%	95%	98%

Table 4. Percent of Estuaries Assessed by Designated Use and Type

Designated Use	Estuary Type			
	Deep Open Water	Channels and Passages	Bays, Inlets, & Harbors	Total All Types
Aquatic Life	100%	100%	100%	100%
Fish Migration	100%	100%	100%	100%
Fish Spawning	100%	100%	100%	100%
Shellfish Spawning	100%	100%	100%	100%
Primary Contact Recreation	100%	100%	100%	100%
Secondary Contact Recreation	100%	100%	100%	100%
Shellfish Harvesting	100%	100%	100%	100%
Overall Use	100%	100%	100%	100%

Table 5. Overall Use Support of Streams

Strata	Rating	Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	Good	1,483	68%	9%
	Fair	395	18%	8%
	Poor	297	14%	7%
Small Streams	Good	25,934	39%	6%
	Fair	17,156	26%	6%
	Poor	23,939	36%	6%
Coast Range Ecoregion	Good	3,541	56%	19%
	Fair	1,417	22%	16%
	Poor	1,417	22%	16%
Puget Lowlands Ecoregion	Good	3,408	43%	8%
	Fair	1,785	22%	7%
	Poor	2,759	35%	8%
Willamette Valley Ecoregion	Good	284	50%	41%
	Fair	142	25%	36%
	Poor	142	25%	36%
Cascades Ecoregion	Good	14,217	80%	15%
	Fair	889	5%	8%
	Poor	2,666	15%	13%
East Cascades and Foothills Ecoregion	Good	2,030	63%	28%
	Fair	812	25%	25%
	Poor	406	13%	19%
Columbia Basin Ecoregion	Good	8,585	34%	10%
	Fair	7,767	31%	10%
	Poor	8,994	35%	10%
Northern Rockies Ecoregion	Good	4,463	57%	17%
	Fair	2,060	26%	15%
	Poor	1,373	17%	13%
Blue Mountains Ecoregion	Good	50	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
All Streams Statewide	Good	32,532	47%	5%
	Fair	16,266	24%	5%
	Poor	20,406	29%	5%

Table 6. Aquatic Life Use Support of Streams

Strata	Rating	Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	Good	1,812	83%	14%
	Fair	198	6%	9%
	Poor	165	11%	12%
Small Streams	Good	58,499	91%	5%
	Fair	4,875	6%	4%
	Poor	3,656	3%	3%
Coast Range Ecoregion	Good	5,312	83%	14%
	Fair	354	6%	9%
	Poor	708	11%	12%
Puget Lowlands Ecoregion	Good	7,205	91%	5%
	Fair	497	6%	4%
	Poor	249	3%	3%
Willamette Valley Ecoregion	Good	568	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Cascades Ecoregion	Good	17,771	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
East Cascades and Foothills Ecoregion	Good	3,249	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Columbia Basin Ecoregion	Good	18,396	73%	9%
	Fair	3,270	13%	7%
	Poor	3,679	15%	7%
Northern Rockies Ecoregion	Good	6,866	87%	12%
	Fair	1,030	13%	12%
	Poor	0	0%	0%
Blue Mountains Ecoregion	Good	50	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
All Streams Statewide	Good	59,617	86%	4%
	Fair	5,392	8%	3%
	Poor	4,194	6%	3%

Table 7. Fish Migration Use Support of Streams

Strata	Rating	Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	Good	1,746	80%	8%
	Fair	214	10%	6%
	Poor	214	10%	6%
Small Streams	Good	64,203	96%	3%
	Fair	2,423	4%	2%
	Poor	404	1%	1%
Coast Range Ecoregion	Good	4,250	67%	16%
	Fair	266	4%	7%
	Poor	1,859	29%	15%
Puget Lowlands Ecoregion	Good	7,620	96%	3%
	Fair	249	3%	3%
	Poor	83	1%	2%
Willamette Valley Ecoregion	Good	568	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Cascades Ecoregion	Good	17,771	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
East Cascades and Foothills Ecoregion	Good	2,843	88%	19%
	Fair	406	13%	19%
	Poor	0	0%	0%
Columbia Basin Ecoregion	Good	22,437	89%	7%
	Fair	2,909	1%	7%
	Poor	0	0%	0%
Northern Rockies Ecoregion	Good	7,553	96%	7%
	Fair	343	4%	7%
	Poor	0	0%	0%
Blue Mountains Ecoregion	Good	50	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
All Streams Statewide	Good	63,072	91%	3%
	Fair	3,796	5%	2%
	Poor	2,336	3%	2%

Table 8. Fish Spawning Use Support of Streams

Strata	Rating	Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	Good	1,911	88%	7%
	Fair	165	8%	5%
	Poor	99	5%	4%
Small Streams	Good	61,906	92%	3%
	Fair	2,989	4%	3%
	Poor	2,135	3%	2%
Coast Range Ecoregion	Good	5,312	83%	14%
	Fair	708	11%	12%
	Poor	354	6%	9%
Puget Lowlands Ecoregion	Good	7,494	94%	4%
	Fair	183	2%	3%
	Poor	274	3%	3%
Willamette Valley Ecoregion	Good	568	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Cascades Ecoregion	Good	16,882	95%	8%
	Fair	889	5%	8%
	Poor	0	0%	0%
East Cascades and Foothills Ecoregion	Good	3,249	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Columbia Basin Ecoregion	Good	21,257	84%	8%
	Fair	2,453	10%	6%
	Poor	1,635	6%	5%
Northern Rockies Ecoregion	Good	7,553	96%	7%
	Fair	343	4%	7%
	Poor	0	0%	0%
Blue Mountains Ecoregion	Good	50	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
All Streams Statewide	Good	62,997	91%	3%
	Fair	3,724	5%	2%
	Poor	2,482	4%	2%

Table 9. Salmon Spawning Use Support of Streams

Strata	Rating	Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	Good	1,933	89%	7%
	Fair	173	8%	6%
	Poor	69	3%	4%
Small Streams	Good	60,285	90%	4%
	Fair	3,794	6%	3%
	Poor	2,951	4%	3%
Coast Range Ecoregion	Good	6,374	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Puget Lowlands Ecoregion	Good	7,288	92%	5%
	Fair	414	5%	4%
	Poor	249	3%	3%
Willamette Valley Ecoregion	Good	568	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Cascades Ecoregion	Good	16,882	95%	8%
	Fair	889	5%	8%
	Poor	0	0%	0%
East Cascades and Foothills Ecoregion	Good	3,249	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Columbia Basin Ecoregion	Good	19,713	78%	9%
	Fair	3,286	13%	8%
	Poor	2,347	9%	6%
Northern Rockies Ecoregion	Good	7,210	91%	10%
	Fair	343	4%	7%
	Poor	343	4%	7%
Blue Mountains Ecoregion	Good	50	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
All Streams Statewide	Good	69,034	90%	3%
	Fair	4,364	6%	3%
	Poor	2,806	4%	2%

Table 10. Wildlife Habitat Use Support of Streams

Strata	Rating	Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	Good	NA	NA	NA
	Fair	NA	NA	NA
	Poor	NA	NA	NA
Small Streams	Good	16,824	40%	21%
	Fair	16,824	40%	21%
	Poor	8,412	20%	17%
Coast Range Ecoregion	Good	4,592	75%	36%
	Fair	1,531	25%	36%
	Poor	0	0%	0%
Puget Lowlands Ecoregion	Good	0	0%	0%
	Fair	0	0%	0%
	Poor	7,553	100%	0%
Willamette Valley Ecoregion	Good	NA	NA	NA
	Fair	NA	NA	NA
	Poor	NA	NA	NA
Cascades Ecoregion	Good	4,370	25%	36%
	Fair	4,370	25%	35%
	Poor	8,741	50%	41%
East Cascades and Foothills Ecoregion	Good	1,611	50%	41%
	Fair	1,611	50%	41%
	Poor	0	0%	0%
Columbia Basin Ecoregion	Good	NA	NA	NA
	Fair	NA	NA	NA
	Poor	NA	NA	NA
Northern Rockies Ecoregion	Good	0	0%	0%
	Fair	7,681	100%	0%
	Poor	0	0%	0%
Blue Mountains Ecoregion	Good	NA	NA	NA
	Fair	NA	NA	NA
	Poor	NA	NA	NA
All Streams Statewide	Good	16,824	40%	21%
	Fair	16,824	40%	21%
	Poor	8,412	20%	17%

Table 11. Fish Consumption Use Support of Streams

Strata	Rating	Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	Good	1,526	71%	20%
	Fair	305	14%	15%
	Poor	305	14%	15%
Small Streams	Good	35,231	89%	17%
	Fair	0	0%	0%
	Poor	4,404	11%	17%
Coast Range Ecoregion	Good	NA	NA	NA
	Fair	NA	NA	NA
	Poor	NA	NA	NA
Puget Lowlands Ecoregion	Good	7,951	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Willamette Valley Ecoregion	Good	NA	NA	NA
	Fair	NA	NA	NA
	Poor	NA	NA	NA
Cascades Ecoregion	Good	289	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
East Cascades and Foothills Ecoregion	Good	0	0%	0%
	Fair	0	0%	0%
	Poor	26	100%	0%
Columbia Basin Ecoregion	Good	10,138	40%	36%
	Fair	5,069	20%	29%
	Poor	10,138	40%	36%
Northern Rockies Ecoregion	Good	5,922	75%	36%
	Fair	1,974	25%	36%
	Poor	0	0%	0%
Blue Mountains Ecoregion	Good	NA	NA	NA
	Fair	NA	NA	NA
	Poor	NA	NA	NA
All Streams Statewide	Good	32,484	78%	14%
	Fair	3,609	9%	10%
	Poor	5,414	13%	12%

Table 12. Primary Contact Recreation Use Support of Streams

Strata	Rating	Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	Good	1,835	84%	7%
	Fair	204	9%	6%
	Poor	136	6%	5%
Small Streams	Good	30,591	46%	7%
	Fair	16,645	25%	6%
	Poor	19,794	30%	6%
Coast Range Ecoregion	Good	4,500	71%	18%
	Fair	1,125	18%	15%
	Poor	750	12%	13%
Puget Lowlands Ecoregion	Good	3,975	50%	9%
	Fair	1,757	22%	7%
	Poor	2,219	28%	8%
Willamette Valley Ecoregion	Good	284	50%	41%
	Fair	142	25%	36%
	Poor	142	25%	36%
Cascades Ecoregion	Good	14,217	80%	15%
	Fair	889	5%	8%
	Poor	2,666	15%	13%
East Cascades and Foothills Ecoregion	Good	2,030	63%	28%
	Fair	812	25%	25%
	Poor	406	13%	19%
Columbia Basin Ecoregion	Good	14,081	56%	11%
	Fair	5,163	20%	9%
	Poor	6,102	24%	10%
Northern Rockies Ecoregion	Good	4,463	57%	17%
	Fair	2,060	26%	15%
	Poor	1,373	17%	13%
Blue Mountains Ecoregion	Good	50	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
All Streams Statewide	Good	39,638	57%	6%
	Fair	13,971	20%	5%
	Poor	15,595	23%	5%

Table 13. Secondary Contact Recreation Use Support of Streams

Strata	Rating	Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	Good	2,076	95%	4%
	Fair	33	2%	2%
	Poor	66	3%	3%
Small Streams	Good	41,591	62%	6%
	Fair	14,537	22%	5%
	Poor	10,902	16%	5%
Coast Range Ecoregion	Good	5,666	89%	12%
	Fair	708	11%	12%
	Poor	0	0%	0%
Puget Lowlands Ecoregion	Good	5,052	64%	8%
	Fair	1,574	20%	7%
	Poor	1,325	17%	6%
Willamette Valley Ecoregion	Good	426	75%	36%
	Fair	0	0%	0%
	Poor	142	25%	36%
Cascades Ecoregion	Good	15,105	85%	13%
	Fair	889	5%	8%
	Poor	1,777	10%	11%
East Cascades and Foothills Ecoregion	Good	2,843	88%	19%
	Fair	0	0%	0%
	Poor	406	13%	19%
Columbia Basin Ecoregion	Good	17,987	71%	9%
	Fair	4,088	16%	8%
	Poor	3,270	13%	7%
Northern Rockies Ecoregion	Good	5,836	74%	15%
	Fair	1,716	22%	14%
	Poor	343	4%	7%
Blue Mountains Ecoregion	Good	50	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
All Streams Statewide	Good	49,517	72%	5%
	Fair	11,037	16%	4%
	Poor	8,651	13%	4%

Table 14. Overall Use Support of Estuaries

Strata	Rating	Size (sq. miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	Good	1,415.1	75%	25%
	Fair	235.8	13%	19%
	Poor	235.8	13%	19%
Channels and Passages	Good	352.1	65%	18%
	Fair	108.3	20%	15%
	Poor	81.2	15%	13%
Bays, Inlets, and Harbors	Good	243.0	51%	12%
	Fair	116.2	24%	11%
	Poor	116.2	24%	11%
All Estuary Areas	Good	1,670.7	58%	10%
	Fair	636.5	22%	8%
	Poor	596.7	21%	8%

Table 15. Aquatic Life Use Support of Estuaries

Strata	Rating	Size (sq. miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	Good	628.9	33%	26%
	Fair	838.6	44%	27%
	Poor	419.3	22%	23%
Channels and Passages	Good	243.7	45%	18%
	Fair	216.7	40%	18%
	Poor	81.2	15%	13%
Bays, Inlets, and Harbors	Good	90.6	19%	10%
	Fair	181.1	38%	12%
	Poor	203.8	43%	13%
All Estuary Areas	Good	818.0	28%	9%
	Fair	1,145.2	39%	10%
	Poor	940.7	32%	9%

Table 16. Fish Migration Use Support of Estuaries

Strata	Rating	Size (sq. miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	Good	1,886.8	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Channels and Passages	Good	514.6	95%	8%
	Fair	0	0%	0%
	Poor	27.1	5%	8%
Bays, Inlets, and Harbors	Good	444.5	93%	6%
	Fair	0	0%	0%
	Poor	31.0	7%	6%
All Estuary Areas	Good	2,746.9	95%	4%
	Fair	0	0%	0%
	Poor	157.0	5%	4%

Table 17. Fish Spawning Use Support of Estuaries

Strata	Rating	Size (sq. miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	Good	1,415.1	75%	25%
	Fair	235.8	13%	19%
	Poor	235.8	13%	19%
Channels and Passages	Good	487.5	90%	11%
	Fair	0	0%	0%
	Poor	54.2	10%	11%
Bays, Inlets, and Harbors	Good	380.4	80%	10%
	Fair	63.4	13%	8%
	Poor	31.7	7%	6%
All Estuary Areas	Good	2,386.7	82%	7%
	Fair	278.5	10%	6%
	Poor	238.7	8%	5%

Table 18. Shellfish Harvesting Use Support of Estuaries

Strata	Rating	Size (sq. miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	Good	471.7	25%	25%
	Fair	471.7	25%	25%
	Poor	943.4	50%	29%
Channels and Passages	Good	379.1	70%	17%
	Fair	27.1	5%	8%
	Poor	135.4	25%	16%
Bays, Inlets, and Harbors	Good	317.0	67%	12%
	Fair	67.9	14%	9%
	Poor	90.6	19%	10%
All Estuary Areas	Good	1,825.3	63%	10%
	Fair	373.4	13%	7%
	Poor	705.2	24%	8%

Table 19. Shellfish Spawning Use Support of Estuaries

Strata	Rating	Size (sq. miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	Good	1,179.2	63%	28%
	Fair	471.7	25%	25%
	Poor	235.8	13%	19%
Channels and Passages	Good	406.2	75%	16%
	Fair	108.3	20%	15%
	Poor	27.1	5%	8%
Bays, Inlets, and Harbors	Good	359.2	76%	11%
	Fair	74.0	16%	9%
	Poor	42.3	9%	7%
All Estuary Areas	Good	2,148.1	74%	8%
	Fair	517.1	18%	7%
	Poor	238.7	8%	5%

Table 20. Primary Contact Recreation Use Support of Estuaries

Strata	Rating	Size (sq. miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	Good	1,886.8	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Channels and Passages	Good	541.6	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Bays, Inlets, and Harbors	Good	457.2	96%	6%
	Fair	18.3	4%	6%
	Poor	0	0%	0%
All Estuary Areas	Good	2,840.7	98%	4%
	Fair	63.1	2%	4%
	Poor	0	0%	0%

Table 21. Secondary Contact Recreation Use Support of Estuaries

Strata	Rating	Size (sq. miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	Good	1,886.8	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Channels and Passages	Good	541.6	100%	0%
	Fair	0	0%	0%
	Poor	0	0%	0%
Bays, Inlets, and Harbors	Good	459.1	97%	6%
	Fair	16.4	3%	6%
	Poor	0	0%	0%
All Estuary Areas	Good	2,844.6	98%	3%
	Fair	59.3	2%	3%
	Poor	0	0%	0%

Table 22. Stream Use Impairments Caused by Temperature

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	2,175	841	33%	10%
Small Streams	67,030	20,339	27%	6%
Coast Range Ecoregion	6,374	84	20%	17%
Puget Lowlands Ecoregion	7,951	1,449	16%	6%
Willamette Valley Ecoregion	568	284	50%	41%
Cascades Ecoregion	17,771	4,809	22%	16%
East Cascades and Foothills Ecoregion	3,249	0	0%	0%
Columbia Basin Ecoregion	25,345	12,067	55%	11%
Northern Rockies Ecoregion	7,896	2,486	33%	17%
Blue Mountains Ecoregion	50	0	0%	0%
All Streams Statewide	69,204	21,180	29%	5%

Table 23. Estuary Use Impairments Caused by Temperature

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	1,886.8	1,617.2	86%	22%
Channels and Passages	541.6	379.1	70%	17%
Bays, Inlets, and Harbors	475.5	285.3	60%	12%
All Estuaries Areas	2,903.9	2,281.6	65%	9%

Table 24. Stream Use Impairments Caused by Dissolved Oxygen

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	2,287	157	6%	5%
Small Streams	67,030	12,732	18%	5%
Coast Range Ecoregion	6,374	28	7%	11%
Puget Lowlands Ecoregion	7,951	1,469	16%	6%
Willamette Valley Ecoregion	681	0	0%	0%
Cascades Ecoregion	17,771	4,786	17%	14%
East Cascades and Foothills Ecoregion	3,249	0	0%	0%
Columbia Basin Ecoregion	25,345	4,661	15%	8%
Northern Rockies Ecoregion	7,896	1,963	24%	15%
Blue Mountains Ecoregion	50	0	0%	0%
All Streams Statewide	69,317	12,889	15%	4%

Table 25. Estuary Use Impairments Caused by Dissolved Oxygen

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	1,886.8	1,886.8	100%	0%
Channels and Passages	541.6	477.9	88%	13%
Bays, Inlets, and Harbors	475.5	289.4	61%	12%
All Estuary Areas	2,903.9	2,654.1	72%	9%

Table 26. Stream Use Impairments Caused by pH

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	2,287	343	14%	7%
Small Streams	67,030	19,653	18%	5%
Coast Range Ecoregion	6,374	28	7%	11%
Puget Lowlands Ecoregion	7,951	105	1%	2%
Willamette Valley Ecoregion	681	0	0%	0%
Cascades Ecoregion	17,771	3,178	11%	12%
East Cascades and Foothills Ecoregion	3,249	1,289	25%	25%
Columbia Basin Ecoregion	25,345	12,515	43%	11%
Northern Rockies Ecoregion	7,896	2,880	29%	16%
Blue Mountains Ecoregion	50	0	0%	0%
All Streams Statewide	69,317	19,996	17%	4%

Table 27. Estuary Use Impairments Caused by pH

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	1,886.8	471.7	25%	25%
Channels and Passages	541.6	127.4	24%	17%
Bays, Inlets, and Harbors	475.5	79.2	17%	9%
All Estuary Areas	2,903.9	678.4	19%	8%

Table 28. Stream Use Impairments Caused by Ammonia-Nitrogen

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	2,287	0	0%	0%
Small Streams	67,030	111	1%	1%
Coast Range Ecoregion	6,374	0	0%	0%
Puget Lowlands Ecoregion	7,951	111	1%	2%
Willamette Valley Ecoregion	681	0	0%	0%
Cascades Ecoregion	17,771	0	0%	0%
East Cascades and Foothills Ecoregion	3,249	0	0%	0%
Columbia Basin Ecoregion	25,345	0	0%	0%
Northern Rockies Ecoregion	7,896	0	0%	0%
Blue Mountains Ecoregion	50	0	0%	0%
All Streams Statewide	69,317	111	0%	1%

Table 29. Estuary Use Impairments Caused by Ammonia-Nitrogen

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	1,886.8	0	0%	0%
Channels and Passages	541.6	0	0%	0%
Bays, Inlets, and Harbors	475.5	0	0%	0%
All Estuary Areas	2,903.9	0	0%	0%

Table 30. Stream Use Impairments Caused by Fecal Coliform

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	2,287	532	24%	9%
Small Streams	67,030	35,790	59%	6%
Coast Range Ecoregion	6,374	2,833	44%	19%
Puget Lowlands Ecoregion	7,951	4,970	57%	8%
Willamette Valley Ecoregion	681	284	50%	41%
Cascades Ecoregion	17,771	6,806	35%	18%
East Cascades and Foothills Ecoregion	3,249	1,933	38%	28%
Columbia Basin Ecoregion	25,345	15,569	45%	10%
Northern Rockies Ecoregion	7,896	3,927	48%	17%
Blue Mountains Ecoregion	50	0	0%	0%
All Streams Statewide	69,317	36,322	49%	5%

Table 31. Estuary Use Impairments Caused by Fecal Coliform

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Deep Open Water Areas	1,886.8	539.1	29%	28%
Channels and Passages	541.6	125.0	23%	19%
Bays, Inlets, and Harbors	475.5	147.6	31%	14%
All Estuary Areas	2,903.9	811.6	29%	11%

Table 32. Stream Use Impairments Caused by Metals

Strata	Assessed Size (miles)	Impaired Size (miles)	Percent of Assessed Size	Precision of Estimate (+/- %)
Large Streams	1,873	1,136	64%	21%
Small Streams	39,635	30,759	50%	26%
Coast Range Ecoregion	0	0	0%	0%
Puget Lowlands Ecoregion	7,951	2,783	50%	24%
Willamette Valley Ecoregion	0	0	0%	0%
Cascades Ecoregion	289	0	0%	0%
East Cascades and Foothills Ecoregion	26	26	100%	0%
Columbia Basin Ecoregion	25,345	25,031	80%	29%
Northern Rockies Ecoregion	7,896	4,056	75%	36%
Blue Mountains Ecoregion	0	0	0%	0%
All Streams Statewide	41,508	31,896	58%	17%

Table 33. Indicators of Use Impairment in Streams

Indicator	Impaired Size (miles)	Percent of Assessed Size
Fecal Coliform	36,322	49%
Metals	31,896	58%
Temperature	21,180	29%
pH	19,996	17%
Dissolved Oxygen	12,889	15%
Ammonia-Nitrogen	111	<1%

Table 34. Indicators of Use Impairment in Estuaries

Indicator	Impaired Size (miles)	Percent of Assessed Size
Dissolved Oxygen	2,654	72%
Temperature	2,282	65%
Fecal Coliform	811	29%
pH	678	19%
Ammonia-Nitrogen	0	0%