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Condition of Fresh Waters in Washington State for the Year 2003

Technical Appendix

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Introduction

This technical appendix presents details about the assessment methods and sampling locations used to develop the report, *Condition of Fresh Waters in Washington State for the Year 2003*.

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Stream Water Quality Index

Water quality indices have been developed that compile large quantities of water quality data and are expressed as single values. Although much detail is lost in summarizing information this way (see "Uses and Limitations"), indices make water quality information accessible to a much broader audience. Couillard and Lefebvre (1985) reviewed several water quality indices that summarize data in an easily understood format.

The Stream Water Quality Index (WQI) is a unitless number ranging from 1 to 100 that is intended to represent general water quality. A higher number indicates better water quality. For constituents with established water quality standards (based on criteria in Washington State's Water Quality Standards, WAC 173-201A), the index expresses results relative to levels required to meet these standards. For constituents without specific standards, results are expressed relative to expected conditions in the appropriate region. Multiple constituents are combined and results aggregated over time to produce a single score for each sample station.

Uses and Limitations

By design, indices contain less information than the raw data that they summarize. An index cannot provide all the information expressed by the original water quality data. An index is most useful for comparative purposes (what stations have particularly poor water quality?) and for general questions (what is the general water quality in my stream?). Indices are less suited to answering specific questions. Site-specific decisions should be based on an analysis of the original water quality data. In short, an index is a useful tool for "communicating water quality information to the lay public and to legislative decision makers;" it is not "a complex predictive model for technical and scientific application" (McClelland, 1974).

Besides being general in nature, there are at least two reasons that an index may fail to accurately communicate water quality information. First, most indexes are based on a pre-identified set of water quality constituents. A particular station may receive a good WQI score, and yet have water quality impaired by constituents not included in the index. Second, aggregation of data may mask short-term water quality problems. A satisfactory WQI at a particular station does not necessarily mean that water quality was always satisfactory. A good score should, however, indicate that poor water quality (for those constituents evaluated) was not chronic.

Strategies

Different approaches to indexing water quality results are possible. The approach we have chosen is one that allows water quality comparisons between measured water quality and water quality necessary to support beneficial uses. However, this approach requires subjective determinations of beneficial uses for each stream segment, the water quality required to support those uses, and the impact resulting from water quality degradation. Expectations for water quality are codified in Washington's Administrative Code (WAC 173-201A). (See Hallock, 2002, for further discussion of alternative strategies.)

Water Quality Constituents Included in the Index

For this analysis, index scores were determined using eight constituents characterized monthly by Ecology's Freshwater Monitoring Unit: temperature, dissolved oxygen (DO), pH, fecal coliform bacteria (FC), total nitrogen (TN), total phosphorus (TP), total suspended sediment (TSS), and turbidity. Rather than aggregating scores for TN and TP separately, the score for the limiting nutrient was used in the aggregation of the overall index because TN and TP are highly correlated and they measure similar impacts on water quality. Similarly, a harmonic mean of sediment-related constituents (TSS and turbidity) was also used. Data collection and quality control are discussed in our annual reports and our Quality Assurance Project Plan (e.g., Hallock, 2003 and Hallock and Ehinger, 2000).

Methodology

The methodology used to determine WQI scores was originally developed by the Environmental Protection Agency (EPA), Region 10. Initial development was reported in Peterson and Bogue (1989). The methodology appears to be based on the well-known National Sanitation Foundation index. This index uses curves to relate concentrations or measurements of various constituents to index scores and then aggregates the scores and expresses them as a single number (Brown et al. 1970). The EPA curves were "a synthesis of national criteria, state standards, information in the technical literature, and professional judgment" (Peterson and Bogue, 1989).

In the 1980s, Ecology produced a WQI using the EPA methods, with further modifications of some curves to align with Washington's Water Quality Standards (e.g. Hallock, 1990). The index was calculated by a Fortran program run on an EPA mainframe computer using data in the national STORET database. These procedures were somewhat cumbersome and Ecology stopped producing the index in the early 1990s. Ecology recently re-programmed the WQI procedures to assess data in Ecology's ambient stream monitoring database.

For temperature, oxygen, pH, and fecal coliform bacteria, data were converted to index scores using the same relationships used by EPA's WQI, except that the original tabulated criteria were converted to quadratic equations. For these constituents, a WQI score is related to the water quality standards criteria for that waterbody and, therefore, reflect the support of beneficial uses.

The original curves for turbidity, TSS, TP, and TN do not account for natural differences caused by wide variations in geomorphology across the state. Furthermore, there are no water quality standards criteria for these constituents. Ecology developed new curves based on the distribution of data at stations within each ecoregion during high- and low-flow seasons. Ecoregions, or ecological regions, are defined by the U.S. EPA (Omernick and Gallant, 1986). WQI scores were matched using several quantiles. A quadratic equation was then fit to the WQI-concentration relationships. Because the index scores for nutrient and sediment constituents are based on the distribution of past data and not on ecological impacts or degree of degradation, poor index scores for these constituents indicate poor water quality relative to other stations in the same ecoregion, and may not necessarily indicate impairment or inability to support beneficial uses. Conversely, good index scores for these constituents may not necessarily indicate a lack of impairment or an ability to support beneficial uses.

The particular formulas used for a particular station and constituent depend on the stream class and ecoregion for that station. Calculated results <1 or >100 are converted to 1 or 100, respectively.

There were insufficient data from three ecoregions to develop independent curves. Curves developed for the Puget Lowlands, Cascades, and Northern Rockies are used for stations in the Willamette Valley, Eastern Cascades Slopes and Foothills, and Blue Mountains ecoregions, respectively. For more information on the WQI methodology, see Hallock (2002).

We made several changes that will affect WQI scores since the last "Conditions" report (Plotnikoff et al., 2003). Scores should not be compared between the two reports. To compare year-to-year changes, see results posted to our website (http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html), where scores were re-calculated using consistent procedures. Changes include the following:

- Procedures were modified to include *dissolved* total phosphorus and nitrogen in the nutrient calculation. (The lab is sometimes forced to filter samples with high sediment concentrations.)
- The water year 2002 WQI used the Cascades Ecoregion for station 45E070. That station is actually in the Columbia Basin Ecoregion.
- The water year 2002 WQI used an incorrect temperature criterion of 20°C for station 36A070. The correct temperature criterion for that station is 18°C.

The WQI was applied to water quality data collected in 2003 (Table 1). To place the WQI scores into categories used for statewide assessment, the cut-points used by EPA in the original WQI were used. According to this categorization scheme, stations with WQI scores 80 and above are considered of "Lowest Concern", scores from 40 to 79 are of "Moderate Concern", and those below 40 are of "Highest Concern."

Table 1. Water Quality Index (WQI) scores for stations sampled in water year 2003. Scores should not be compared to those in the last "Conditions" report (see text).

Station	Location	Ecoregion	WQI
01A050	Nooksack R @ Brennan	Puget Lowlands	60
01A120	Nooksack R @ No Cedarville	Puget Lowlands	70
03A060	Skagit R nr Mount Vernon	Puget Lowlands	77
03B050	Samish R nr Burlington	Puget Lowlands	52
04A100	Skagit R @ Marblemount	Cascades	86
05A070	Stillaguamish R nr Silvana	Puget Lowlands	72
05A090	SF Stillaguamish @ Arlington	Puget Lowlands	71
05A110	SF Stillaguamish nr Granite Falls	Puget Lowlands	67
05B070	NF Stillaguamish @ Cicero	Puget Lowlands	82
05B110	NF Stillaguamish nr Darrington	Cascades	62
07A090	Snohomish R @ Snohomish	Puget Lowlands	82
07C070	Skykomish R @ Monroe	Puget Lowlands	87
07D050	Snoqualmie R nr Monroe	Puget Lowlands	82
07D130	Snoqualmie R @ Snoqualmie	Puget Lowlands	90
08C070	Cedar R @ Logan St/Renton	Puget Lowlands	83
08C110	Cedar R nr Landsburg	Puget Lowlands	94
09A080	Green R @ Tukwila	Puget Lowlands	68
09A190	Green R @ Kanaskat	Puget Lowlands	91
10A050	Puyallup R @ Puyallup	Puget Lowlands	57
10A070	Puyallup R @ Meridian St	Puget Lowlands	59
10C095	White River @ R Street	Puget Lowlands	59
11A070	Nisqually R @ Nisqually	Puget Lowlands	87
13A060	Deschutes R @ E St Bridge	Puget Lowlands	73
15E070	Union R nr Belfair	Puget Lowlands	61
15G050	Little Mission Cr. @ Hwy 300	Puget Lowlands	61
15H050	Stimson Creek @ Hwy 300	Puget Lowlands	79
15J050	Big Mission Cr. @ Hwy 300	Puget Lowlands	62
15K070	Olalla Cr. @ Forsman Rd.	Puget Lowlands	41
16A070	Skokomish R nr Potlatch	Puget Lowlands	85
16C090	Duckabush R nr Brinnon	Coast Range	90
18A050	Dungeness R nr Mouth	Puget Lowlands	92
18B070	Elwha R nr Port Angeles	Coast Range	76
20B070	Hoh R @ DNR Campground	Coast Range	72
22A070	Humptulips R nr Humptulips	Coast Range	79
23A070	Chehalis R @ Porter	Puget Lowlands	66
23A100	Chehalis R @ Prather Rd	Puget Lowlands	65
23A160	Chehalis R @ Dryad	Puget Lowlands	73
24B090	Willapa R nr Willapa	Coast Range	56
24F070	Naselle R nr Naselle	Coast Range	70
26B070	Cowlitz R @ Kelso	Puget Lowlands	79
27B070	Kalama R nr Kalama	Puget Lowlands	93

Station	Location	Ecoregion	WQI
27D090	EF Lewis R nr Dollar Corner	Willamette Valley	88
28A100	Columbia R. @ Vancouver	Willamette Valley	85
31A070	Columbia R @ Umatilla	Columbia Basin	88
32A070	Walla Walla R nr Touchet	Columbia Basin	73
32B075	Touchet R. @ Cummins Rd.	Columbia Basin	54
32C070	Mill Cr @ Swegle Rd	Columbia Basin	63
33A050	Snake R nr Pasco	Columbia Basin	86
34A070	Palouse R @ Hooper	Columbia Basin	57
34A170	Palouse R @ Palouse	Columbia Basin	60
34B110	SF Palouse R @ Pullman	Columbia Basin	26
35A150	Snake R @ Interstate Br	Columbia Basin	75
35B060	Tucannon R @ Powers	Columbia Basin	73
36A070	Columbia R nr Vernita	Columbia Basin	89
37A090	Yakima R @ Kiona	Columbia Basin	67
37A205	Yakima R @ Nob Hill	Columbia Basin	84
39A090	Yakima R nr Cle Elum	Cascades	76
41A070	Crab Cr nr Beverly	Columbia Basin	47
41J070	Lind Coulee @ Hwy 17	Columbia Basin	48
43C070	Goose Creek nr Wilbur	Columbia Basin	77 [a]
45A070	Wenatchee R @ Wenatchee	Columbia Basin	79
45A110	Wenatchee R nr Leavenworth	Cascades	80
45C070	Chumstick Cr nr Leavenworth	Cascades	30 [b]
45D070	Brender Cr nr Cashmere	Columbia Basin	72
45E070	Mission Cr nr Cashmere	Columbia Basin	55
45Q060	Eagle Cr. nr mouth	Cascades	61 [a]
45R050	Noname Creek nr Cashmere	Columbia Basin	57
46A070	Entiat R nr Entiat	Columbia Basin	82
48A070	Methow R nr Pateros	Columbia Basin	90
48A140	Methow R @ Twisp	Columbia Basin	95
49A070	Okanogan R @ Malott	Columbia Basin	72
49A190	Okanogan R @ Oroville	Columbia Basin	73
49B070	Similkameen R @ Oroville	Columbia Basin	80
53A070	Columbia R @ Grand Coulee	Columbia Basin	84
54A120	Spokane R @ Riverside State Pk	Northern Rockies	37
55B070	Little Spokane R nr Mouth	Northern Rockies	57
56A070	Hangman Cr @ Mouth	Columbia Basin	42
57A150	Spokane R @ Stateline Br	Columbia Basin	73
60A070	Kettle R nr Barstow	Northern Rockies	64
61A070	Columbia R @ Northport	Northern Rockies	77
62A090	Pend Oreille R @ Metaline Falls	Northern Rockies	77
62A150	Pend Oreille R @ Newport	Northern Rockies	81

[a] Score not based on a full year's data. Use with caution.
[b] Data from 45C060 and 45C070 were combined.

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Trend Analysis

The presence or absence of trends over time is a good indication of the degree to which water quality is responding to changes in the watershed. Formal statistical trend analysis provides a rational, scientific basis for addressing issues with natural variations in water quality that can obscure human-caused trends. Human-caused changes in water quality can sometimes be determined in spite of natural variability. For example, if a distinct relationship exists between stream flow and a water quality indicator, then a trend in flow may create a trend in the indicator data or obscure a human-caused trend.

The Seasonal Kendall's Tau test is a good choice for evaluating trends when water quality varies by season (Gilbert, 1987). This test can be used even if there are missing values or if values are below the analytical detection limit. The validity of the test does not depend on the assumption that data observations are normally distributed. The statistical software called WQHYDRO (Aroner, 2002) was used to evaluate for trends at each station using the flow-adjusted residual (see below) or raw indicator data at a 95% confidence level for statistical significance.

Water quality constituents are frequently correlated with flow. During high-flow years, some constituents are typically higher (e.g., sediment) and others lower (e.g., temperature) than during low-flow years. As a result, year-to-year changes in an index could actually be attributable to variability in flow (natural or otherwise), rather than to changes in watershed conditions. Therefore, a second set of annual flow-adjusted WQI scores was calculated for long-term stations after removing variability in water quality constituents due to flow. This was done for each station by 1) determining the residuals from a hyperbolic regression of each constituent (raw data) with flow, 2) adding the mean of each constituent back to the residuals, 3) calculating WQIs on the adjusted data, and 4) adjusting mean flow-adjusted annual scores to match the raw indicator means for each station. Flow-adjustments were done with WQHYDRO (Aroner, 2002) and Access©.

An analysis of trends in monthly WQI scores was calculated from data collected from 1994 through 2003 at long-term stations. Trends were also performed on monthly scores adjusted for variability in flow, as described above. Reported probabilities include corrections for auto-correlation where appropriate. Prior to adjusting for flow, statistically significant ($p < 0.05$) improving trends were indicated at 14 stations and declining trends at one station (Table 2). Adjusting for flow decreased the trend slope at two thirds of the stations and resulted in improving trends at 11 stations and declining trends at one station. The affect of flow on WQI trends is station-specific and depends on which constituent(s) drive the WQI at a particular station. Some constituents are positively correlated with flow (e.g., sediment and nutrients) and some negatively (e.g., temperature and pH).

Trends of multiple stations can be evaluated together using a statistical method called meta-analysis (Reckhow et al. 1993). Stations can be grouped from various geographic regions or watershed land uses to draw a collective assessment of trend for each group. Results of the station trend test were used in meta-analysis to evaluate trends in indicators for each ecoregion and also on a statewide basis. A statistically significant improvement in water quality was observed statewide, with the greatest improvement in the Columbia Basin Ecoregion (Table 3).

For that ecoregion, the magnitude of the trend was 0.6 units change per year in the WQI scores over the 10 year period.

Table 2. Trend analysis of monthly overall WQI scores from 1994 through 2003. Statistically significant trends ($p<0.05$) are shown in bold. Positive slopes indicate improving conditions.

		Not Flow-adjusted		Adjusted for Flow	
Station	Location	Slope	Probability (p)	Slope	Probability (p)
01A050	Nooksack R @ Brennan	0.306	0.433	0.276	0.403
01A120	Nooksack R @ No Cedarville	0.314	0.217	-0.01	0.876
03A060	Skagit R nr Mount Vernon	0.1	0.366	-0.021	0.836
03B050	Samish R nr Burlington	**0.764**	**0.001**	**0.724**	**0.002**
04A100	Skagit R @ Marblemount	0.126	0.206	0.025	0.699
05A070	Stillaguamish R nr Silvana	-0.045	0.865	0.164	0.393
05A090	SF Stillaguamish @ Arlington	-0.086	0.928	-0.34	1.000
05A110	SF Stillaguamish nr Granite Falls	0.109	0.567	-2.211	0.773
05B070	NF Stillaguamish @ Cicero	0.321	0.226	0.103	0.546
05B110	NF Stillaguamish nr Darrington	**1.146**	**0.011**	-0.323	0.718
07A090	Snohomish R @ Snohomish	0.234	0.064	0.224	0.140
07C070	Skykomish R @ Monroe	**0.152**	**0.006**	**0.213**	**0.004**
07D050	Snoqualmie R nr Monroe	**0.607**	**0.030**	0.53	0.051
07D130	Snoqualmie R @ Snoqualmie	0.103	0.157	-0.019	0.863
08C070	Cedar R @ Logan St/Renton	0.01	0.963	0.059	0.648
08C110	Cedar R nr Landsburg	0.036	0.315	0.029	0.342
09A080	Green R @ Tukwila	**0.987**	**0.001**	**0.811**	**0.037**
09A190	Green R @ Kanaskat	0.088	0.141	**0.144**	**0.006**
10A070	Puyallup R @ Meridian St	0.22	0.454	0.376	0.225
11A070	Nisqually R @ Nisqually	0.007	0.887	0.189	0.492
13A060	Deschutes R @ E St Bridge	-0.087	0.983	-0.388	0.451
16A070	Skokomish R nr Potlatch	**0.135**	**0.019**	**0.113**	**0.019**
16C090	Duckabush R nr Brinnon	-0.026	0.577	0.026	0.671
18B070	Elwha R nr Port Angeles	0.022	0.661	-0.014	0.853
20B070	Hoh R @ DNR Campground	-0.005	1.000	0.119	0.433
22A070	Humptulips R nr Humptulips	-0.018	0.900	0.236	0.092
23A070	Chehalis R @ Porter	-0.038	0.880	-0.369	0.075
23A160	Chehalis R @ Dryad	-0.163	0.394	0.242	0.457
24B090	Willapa R nr Willapa	0.419	0.393	**0.934**	**0.003**
24F070	Naselle R nr Naselle	-0.064	0.739	0.478	0.140
26B070	Cowlitz R @ Kelso	-0.124	0.765	-0.029	0.923
27B070	Kalama R nr Kalama	-0.088	0.240	**-0.505**	**0.013**
27D090	EF Lewis R nr Dollar Corner	-0.005	0.978	0	1.000
31A070	Columbia R @ Umatilla	**0.154**	**0.025**	0.081	0.160
32A070	Walla Walla R nr Touchet	**1.731**	**0.019**	**0.671**	**0.000**
33A050	Snake R nr Pasco	0.354	0.055	**0.195**	**0.027**
34A070	Palouse R @ Hooper	1.665	0.053	0.998	0.060
34A170	Palouse R @ Palouse	0.349	0.215	**0.562**	**0.015**

		Not Flow-adjusted		Adjusted for Flow	
Station	Location	Slope	Probability (p)	Slope	Probability (p)
34B110	SF Palouse R @ Pullman	**3.277**	**0.000**	**1.864**	**0.000**
35A150	Snake R @ Interstate Br	0.102	0.454	0.042	0.786
35B060	Tucannon R @ Powers	**1.714**	**0.000**	0.465	0.371
36A070	Columbia R nr Vernita	0.106	0.179	0.08	0.337
37A090	Yakima R @ Kiona	**1.281**	**0.001**	**1.472**	**0.012**
37A205	Yakima R @ Nob Hill	0.2	0.235	-0.189	0.330
39A090	Yakima R nr Cle Elum	**0.457**	**0.049**	-0.445	0.177
41A070	Crab Cr nr Beverly	0.44	0.106	0.192	0.547
45A070	Wenatchee R @ Wenatchee	0.078	0.399	0.021	0.893
45A110	Wenatchee R nr Leavenworth	**0.362**	**0.025**	0.152	0.100
46A070	Entiat R nr Entiat	-0.014	0.857	0.003	1.000
48A070	Methow R nr Pateros	**-0.118**	**0.015**	-0.1	0.095
48A140	Methow R @ Twisp	-0.046	0.315	-0.048	0.235
49A070	Okanogan R @ Malott	0.234	0.100	0.111	0.466
49A190	Okanogan R @ Oroville	-0.006	0.984	-0.015	0.915
49B070	Similkameen R @ Oroville	**0.202**	**0.012**	0.186	0.328
53A070	Columbia R @ Grand Coulee	0.094	0.076	0.07	0.229
54A120	Spokane R @ Riverside State Pk	0.101	0.857	0.139	0.624
55B070	Little Spokane R nr Mouth	-0.744	0.208	-0.368	0.273
56A070	Hangman Cr @ Mouth	1.247	0.105	0.416	0.105
57A150	Spokane R @ Stateline Br	-0.038	0.622	-0.073	0.412
60A070	Kettle R nr Barstow	0.076	0.613	-0.061	0.555
61A070	Columbia R @ Northport	0.081	0.341	0.04	0.823
62A090	Pend Oreille R @ Metaline Falls	0.097	0.551	-0.064	0.551
62A150	Pend Oreille R @ Newport	0.155	0.184	-0.066	0.696

Table 3. Regional Trends in WQI.

Ecoregion	Number of Stations	WQI		
		Regional Z score	Probability	Mean Change Last 10 years (WQI units)
Coast Range	6	0.112	0.91	Not significant
Puget Lowlands	24	4.644	**<0.01**	0.16
Willamette Valley	1	-0.028	0.98	Not significant
Cascades	4	4.015	**<0.01**	0.52
Columbia Basin	22	7.236	**<0.01**	0.59
Northern Rockies	5	0.764	0.44	Not significant
Statewide	62	8.468	**<0.01**	0.31

Bold indicates a statistically significant trend was found

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Water Quality of Basin Stations

Basin stations are generally monitored for one year only (although they may be re-visited every five years) to collect current water quality information. The basin monitoring stations are selected to support Ecology's basin approach to water quality management and to address site-specific water quality issues. These stations are selected to support the wastewater discharge permitting process, TMDL assessments, site-specific needs, and to allow expanded coverage over a long-term network. Some basin stations are selected to target known problems and may not necessarily reflect general ambient conditions. The current basin station monitoring program conducts monthly monitoring of 12 water quality constituents at approximately 20 stations across the state. During water year 2003, basin station sampling was focused in the following areas: Puyallup, Kitsap, Chehalis, Wenatchee, Touchet, Crab Creek and Pend Oreille. Water quality data collected at the basin monitoring stations sampled in water year 2003 were assessed against the numeric criteria in Washington's Water Quality Standards (Table 4).

Table 4. Water quality criteria used to evaluate monitoring results. (Results outside the ranges indicated are considered to exceed the criterion.) WAC 173-201A-130 identifies exceptions to the standard criteria for some stream segments.

	Temperature	Oxygen	pH	Fecal Coliform (colonies/100mL)	
Class	(°C)	(mg/L)	(standard units)	10 Percent	Geometric mean
AA	<=16	>9.5	6.5<=pH<=8.5	<=100	<=50
A	<=18	>8.0	6.5<=pH<=8.5	<=200	<=100
B	<=21	>6.5	6.5<=pH<=8.5	<=400	<=200

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Continuous Temperature Measurements

In the summer of 2003, the Environmental Monitoring and Trends Section (EMTS) continued for a third year collecting temperature data at 30-minute intervals at most of our long-term ambient monitoring stations as well as some basin stations. Fifty-four sites were monitored in 2003. The purpose of this monitoring is to collect season-long diurnal temperature data that may be used for trend analyses and to determine compliance with current and proposed water quality standards.

"Seasonal maximums" and the "maximum seven-day average of daily maximums" were derived for the 54 stations monitored in 2003. The seasonal maximum at most stations (43) exceeded criteria established as the water quality standard (Table 5). A new temperature criterion of 16˚C based on the maximum seven-day average of maximum daily measurements is being proposed as a water quality standard for most streams in Washington. Forty-five stations would have exceeded this criterion.

Table 5. Temperature monitoring (30-minute intervals) - summary for water year 2003. Temperatures in bold exceed the current or proposed (max 7-day mean=16ºC) water quality criterion.

Station	Location	Current Criterion	Deployment Maximum °C	Deployment Maximum Date/Time [a]	Max 7-day Mean [a] °C	Max 7-day Mean Date [b]
01A050	Nooksack R @ Brennan	18	**18.6**	17:00 14-Aug	**18.0**	17-Aug
01A120	Nooksack R @ No Cedarville	18	**18.9**	19:30 29-Jul	**18.4**	28-Jul
03B050	Samish R nr Burlington	18	**19.1**	18:30 30-Jul	**18.3**	29-Jul
04A100	Skagit R @ Marblemount	16	14.1	17:30 30-Jul	13.8	30-Jul
05A070	Stillaguamish R nr Silvana	18	**24.7**	19:00 30-Jul	**23.4**	29-Jul
05A090	SF Stillaguamish @ Arlington	18	**26.1**	19:00 30-Jul	**24.9**	29-Jul
05A110	SF Stillaguamish nr Granite Falls	16	**23.2**	14:30 30-Jul	**22.1**	30-Jul
05B070	NF Stillaguamish @ Cicero	18	**23.2**	18:30 30-Jul	**22.3**	29-Jul
05B110	NF Stillaguamish nr Darrington	18	**19.8**	17:00 30-Jul	**19.2**	29-Jul
07C070	Skykomish R @ Monroe	18	**22.1**	20:30 30-Jul	**21.3**	30-Jul
07D050	Snoqualmie R nr Monroe	18	**23.2**	14:30 31-Jul	**22.2**	31-Jul
07D130	Snoqualmie R @ Snoqualmie	18	**21.0**	22:30 30-Jul	**20.5**	29-Jul
08C070	Cedar R @ Logan St/Renton	18	**21.4**	18:00 30-Jul	**20.5**	29-Jul
08C110	Cedar R nr Landsburg	16	14.7	16:00 30-Jul	14.3	30-Jul
09A190	Green R @ Kanaskat	16	**19.9**	17:30 18-Aug	**19.3**	02-Sep
10A050	Puyallup R @ Puyallup	18	**18.9**	23:00 30-Jul	**18.4**	29-Jul
10C095	White River @ R Street	18	**21.6**	18:00 17-Aug	**20.5**	17-Aug
11A070	Nisqually R @ Nisqually	18	18.0	18:00 30-Jul	**17.5**	28-Jul
13A060	Deschutes R @ E St Bridge	18	**20.8**	19:00 30-Jul	**19.9**	28-Jul
15E070	Union R nr Belfair	16	15.9	16:00 30-Jul	15.1	29-Jul
15G050	Little Mission Cr. @ Hwy 300	16	13.3	17:00 30-Jul	12.8	29-Jul
15H050	Stimson Creek @ Hwy 300	16	15.8	16:30 30-Jul	15.0	28-Jul
15J050	Big Mission Cr. @ Hwy 300	16	**18.0**	18:30 30-Jul	**17.2**	28-Jul
15K070	Olalla Cr. @ Forsman Rd.	16	15.6	20:00 30-Jul	14.9	28-Jul
16A070	Skokomish R nr Potlatch	16	15.1	18:30 20-Jul	14.7	20-Jul
16C090	Duckabush R nr Brinnon	16	15.1	17:00 30-Jul	14.4	30-Jul
18A050	Dungeness R nr Mouth	18	**18.3**	16:30 30-Jul	**17.5**	30-Jul
18B070	Elwha R nr Port Angeles	16	**17.7**	17:30 21-Aug	**17.2**	18-Aug
20B070	Hoh R @ DNR Campground	16	**18.0**	20:00 29-Jul	**17.2**	30-Jul
22A070	Humptulips R nr Humptulips	18	**23.3**	19:30 29-Jul	**21.9**	29-Jul
23A070	Chehalis R @ Porter	18	**25.5**	18:30 30-Jul	**24.1**	29-Jul
23A160	Chehalis R @ Dryad	18	**25.0**	18:00 30-Jul	**23.5**	28-Jul
24F070	Naselle R nr Naselle	18	**22.3**	17:00 30-Jul	**21.1**	30-Jul
26B070	Cowlitz R @ Kelso	18	**19.7**	18:00 29-Jul	**18.9**	30-Jul
27B070	Kalama R nr Kalama	18	**21.2**	19:00 30-Jul	**20.3**	30-Jul
27D090	EF Lewis R nr Dollar Corner	18	**27.0**	17:00 30-Jul	**25.9**	29-Jul
32A070	Walla Walla R nr Touchet	21	**31.2**	17:00 22-Jul	**30.0**	21-Jul
34A170	Palouse R @ Palouse	20	**29.1**	17:30 22-Jul	**28.3**	29-Jul
34B110	SF Palouse R @ Pullman	18	**22.6**	19:00 27-Jul	**22.4**	20-Jul
35B060	Tucannon R @ Powers	18	**27.2**	18:00 22-Jul	**26.5**	21-Jul
39A090	Yakima R nr Cle Elum	16	**21.7**	17:00 31-Jul	**21.2**	30-Jul
41A070	Crab Cr nr Beverly	21	**29.8**	19:30 28-Jul	**28.8**	29-Jul
45C070	Chumstick Cr nr Leavenworth	18	15.5	18:00 26-Jul	14.7	13-Jul
45D070	Brender Cr nr Cashmere	18	**19.6**	16:30 23-Jul	**19.1**	29-Jul
45E070	Mission Cr nr Cashmere	18	**22.5**	16:30 20-Jul	**20.8**	17-Jul
45Q060	Eagle Cr. nr mouth	18	17.5	15:30 05-Jul	**16.6**	06-Jul
45R050	Noname Creek nr Cashmere	18	**20.4**	17:00 01-Aug	**20.0**	29-Jul
46A070	Entiat R nr Entiat	18	**23.6**	17:00 31-Jul	**22.8**	29-Jul
48A070	Methow R nr Pateros	18	**24.6**	18:00 01-Aug	**23.8**	29-Jul
48A140	Methow R @ Twisp	18	**20.4**	18:00 31-Jul	**20.1**	29-Jul
49A190	Okanogan R @ Oroville	18	**28.8**	18:30 01-Aug	**27.2**	31-Jul
49B070	Similkameen R @ Oroville	18	**28.0**	16:30 01-Aug	**26.8**	30-Jul
55B070	Little Spokane R nr Mouth	18	**18.1**	20:00 23-Jul	**17.9**	21-Jul
56A070	Hangman Cr @ Mouth	18	**26.1**	20:00 22-Jul	**25.5**	22-Jul

[a] This is the seven-day period with the highest average of daily maximum temperatures.
[b] There may be other dates or other seven day periods with the same maximum. Date shown is middle of the seven day period.

Sanitary Conditions

Acceptable water quality for the support of swimming and shellfish harvesting is commonly determined by use of the indicator bacteria, fecal coliform. Since it is impossible to test for all pathogenic organisms, fecal coliform bacteria is used as a surrogate indicator of pathogens. Fecal coliform bacteria originate from the intestinal tract of warm-blooded animals and concentrations in water are relatively easy to measure. Because of this, water quality standards for fecal coliform have been promulgated to protect beneficial uses including swimming and shellfish harvesting.

The water quality standards for fecal coliform are based on statistical criteria of the data distribution. The standard has two criteria based on the geometric mean and the 10th percentile. Data collected from each station must be assessed for compliance using the distribution of observations. Also, any evaluation of the reduction in fecal coliform needed to comply with standards must take into account this site-specific distribution so that both criteria are met.

One approach used to determine the required reduction of fecal coliform concentrations is the Statistical Rollback Method (Ott, 1995). This approach can be used to evaluate the distribution of existing observations against the two fecal coliform water quality criteria. Only eight of the long-term stream monitoring stations evaluated (13%) violated the water quality standards during 2003. Of these stations, most exceeded the 10^{th} percentile criterion, but not the geometric mean criterion. The Statistical Rollback Method was applied to these data, and the percent reduction in fecal coliform levels needed to meet the standards was described (Table 6). These reductions are based on an assumption that the distribution of observations will not change when fecal coliform levels are reduced. Information on the amount of fecal coliform loading that needs to be reduced may help indicate where pollution control efforts should be targeted.

Table 6. Fecal Coliform Levels Sampled in 2003 and the Percent Reductions Required to meet Water Quality Standards.

Station	Location	Water Class	Geometric Mean (cfu/100mL)	90th Percentile (cfu/100mL)	Percent Reduction Required
01A050	Nooksack R @ Brennan	A	24	98	0
01A120	Nooksack R @ No Cedarville	A	10	66	0
03A060	Skagit R nr Mount Vernon	A	4	16	0
03B050	Samish R nr Burlington	A	47	179	0
04A100	Skagit R @ Marblemount	AA	2	4	0
05A070	Stillaguamish R nr Silvana	A	12	59	0
05A090	SF Stillaguamish @ Arlington	A	16	89	0
05A110	SF Stillaguamish nr Granite Falls	AA	6	36	0
05B070	NF Stillaguamish @ Cicero	A	7	51	0
05B110	NF Stillaguamish nr Darrington	A	6	21	0
07A090	Snohomish R @ Snohomish	A	22	70	0
07C070	Skykomish R @ Monroe	A	5	25	0
07D050	Snoqualmie R nr Monroe	A	21	94	0
07D130	Snoqualmie R @ Snoqualmie	A	13	39	0
08C070	Cedar R @ Logan St/Renton	A	43	220	9%
08C110	Cedar R nr Landsburg	AA	2	11	0
09A080	Green R @ Tukwila	A	35	103	0
09A190	Green R @ Kanaskat	AA	4	19	0
10A070	Puyallup R @ Meridian St	A	41	215	7%
11A070	Nisqually R @ Nisqually	A	6	28	0
13A060	Deschutes R @ E St Bridge	A	42	358	44%
16A070	Skokomish R nr Potlatch	AA	5	29	0
16C090	Duckabush R nr Brinnon	AA	2	8	0
18B070	Elwha R nr Port Angeles	AA	2	11	0
20B070	Hoh R @ DNR Campground	AA	4	30	0
22A070	Humptulips R nr Humptulips	A	7	41	0
23A070	Chehalis R @ Porter	A	28	113	0
23A100	Chehalis R @ Prather Rd	A	21	151	0
23A160	Chehalis R @ Dryad	A	14	43	0
24B090	Willapa R nr Willapa	A	24	146	0
24F070	Naselle R nr Naselle	A	17	74	0
26B070	Cowlitz R @ Kelso	A	13	43	0
27B070	Kalama R nr Kalama	A	17	70	0
27D090	EF Lewis R nr Dollar Corner	A	14	95	0
31A070	Columbia R @ Umatilla	A	3	7	0
32A070	Walla Walla R nr Touchet	B	52	204	0
33A050	Snake R nr Pasco	A	1	3	0
34A070	Palouse R @ Hooper	B	54	291	0
34A170	Palouse R @ Palouse	A	42	407	51%
34B110	SF Palouse R @ Pullman	A	140	2244	91%
35A150	Snake R @ Interstate Br	A	5	23	0

Station	Location	Water Class	Geometric Mean (cfu/100mL)	90th Percentile (cfu/100mL)	Percent Reduction Required
35B060	Tucannon R @ Powers	A	47	217	8%
36A070	Columbia R nr Vernita	A	1	3	0
37A090	Yakima R @ Kiona	A	12	41	0
37A205	Yakima R @ Nob Hill	A	9	38	0
39A090	Yakima R nr Cle Elum	AA	4	20	0
41A070	Crab Cr nr Beverly	B	38	181	0
45A070	Wenatchee R @ Wenatchee	A	4	15	0
45A110	Wenatchee R nr Leavenworth	AA	2	5	0
46A070	Entiat R nr Entiat	A	2	7	0
48A070	Methow R nr Pateros	A	1	4	0
48A140	Methow R @ Twisp	A	3	9	0
49A070	Okanogan R @ Malott	A	13	104	0
49A190	Okanogan R @ Oroville	A	3	11	0
49B070	Similkameen R @ Oroville	A	4	17	0
53A070	Columbia R @ Grand Coulee	A	2	15	0
54A120	Spokane R @ Riverside State Pk	A	26	318	37%
55B070	Little Spokane R nr Mouth	A	42	185	0
56A070	Hangman Cr @ Mouth	A	74	666	70%
57A150	Spokane R @ Stateline Br	A	6	41	0
60A070	Kettle R nr Barstow	AA	4	17	0
61A070	Columbia R @ Northport	AA	4	16	0
62A150	Pend Oreille R @ Newport	A	1	4	0

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Biological Health

We surveyed 31 sites in 2003. The biological condition of these sites is presented in terms of multimetric index scores (Benthic-Index of Biological Integrity, B-IBI) (Table 7). Sites labeled as impaired had index scores below the 25th percentile of their associated reference stream distribution. Sites labeled as "healthy" had index scores above the 25th percentile of their associated reference stream distribution.

We also report the condition of benthic macroinvertebrate communities using a mathematical model that predicts common species expected to occur in Western Washington streams, and compares the predictions with data collected in the field. This mathematical modeling approach is called the River InVertebrate Prediction and Classification System (RIVPACS). The RIVPACS model uses landscape and physical stream characteristics that are independent of human disturbance to assemble lists of species that are expected to occur naturally in different stream settings (Wright, et. Al 1993). Once a list of expected species is assembled for a stream site, it is compared with the collected (observed) species list and a score is reported as a ratio of observed/expected taxa. In the case of the RIVPACS model developed for Western Washington streams, a score of 0.86 (i.e., 86% of expected taxa were observed) and greater is interpreted as meeting biological expectations, with 90% confidence. Those sites scoring less are considered degraded. We do not yet have sufficient data to develop RIVPACS scores for Eastern Washington streams.

Table 7. Observed vs. expected aquatic macroinvertebrate community compositions measured in 2003.

WRIA	Site_name	Date	RIVPACS Score [a]	RIVPACS Condition	B-IBI Index	B_IBI Condition
1	Austin Cr	09/30/2003	1.14	Good	44	Healthy
1	Chuckanut Cr @ Aroyo Park	09/30/2003	0.98	Good	42	Healthy
4	Diobsud Cr	09/29/2003	1.00	Good	32	Healthy
18	South Branch Little R	10/01/2003	N/A	N/A	44	Healthy
24	Ellsworth Cr	10/15/2003	N/A	N/A	38	Healthy
29	Trapper Cr at Trapper Cr Wilderness	10/14/2003	N/A	N/A	38	Healthy
34	Palouse R at Palouse	07/16/2003	N/A	N/A	22	Impaired
34	Palouse River @ Hooper	10/07/2003	N/A	N/A	26	Impaired
34	S.F. Palouse R nr Pullman	07/16/2003	N/A	N/A	16	Impaired
34	S.F. Palouse R nr Pullman	10/08/2003	N/A	N/A	18	Impaired
35	Cummings Cr at Wooten	10/06/2003	N/A	N/A	44	Healthy
38	Oak Creek	08/26/2003	N/A	N/A	40	Healthy
39	Middle Fork Teanaway R	08/25/2003	0.98	Good	36	Healthy
39	Umtanum Cr nr Durr Rd	08/25/2003	N/A	N/A	34	Healthy
55	Deadman Cr nr Mouth	07/18/2003	N/A	N/A	36	Healthy
56	California Cr nr mouth	08/13/2003	N/A	N/A	34	Healthy
56	Hangman Cr @ Bradshaw Rd	08/12/2003	N/A	N/A	24	Impaired
56	Hangman Cr @ Mouth	08/11/2003	N/A	N/A	28	Impaired
56	Hangman Cr @ Mouth	10/07/2003	N/A	N/A	26	Impaired
56	Hangman Cr. Tekoa	08/14/2003	N/A	N/A	22	Impaired
56	Marshall Cr	08/13/2003	N/A	N/A	32	Impaired
56	Rattlers Run Cr. @ Mouth	08/12/2003	N/A	N/A	28	Impaired
56	Rock Cr. at Jackson Rd. Bridge	08/14/2003	N/A	N/A	30	Impaired
58	N.F. Hall Cr	07/31/2003	N/A	N/A	50	Healthy
58	Sherman Cr	07/30/2003	N/A	N/A	40	Healthy
59	Colville River below Sheep Cr	07/17/2003	N/A	N/A	36	Healthy
59	Deer Cr nr mouth	07/17/2003	N/A	N/A	26	Impaired
59	Stensgar Cr nr Mouth	07/17/2003	N/A	N/A	32	Impaired
60	Kettle River @ Barstow	07/30/2003	N/A	N/A	20	Impaired
62	Gypsy Cr	07/29/2003	N/A	N/A	42	Healthy
62	North Fork Sullivan Cr	07/28/2003	N/A	N/A	46	Healthy

[a] n/a indicates RIVPACS model not currently available for these sites. Scores below 86% indicate degraded conditions and are shown in bold.

Aquatic Weeds

The Washington State Department of Ecology has been collecting information on aquatic plants from lakes and rivers throughout the state since 1994. The main objective of this program is to inventory and monitor the spread of invasive exotic (non-native) aquatic plant species throughout the state. Other goals of the program are to provide technical assistance on aquatic plant identification and control of invasive species, and to conduct special projects evaluating the impacts of invasive non-native species and their control.

For most lakes the method used is to circumnavigate the littoral zone in a small boat. When a different plant or type of habitat is observed, samples are collected for identification. Notes on species distribution, abundance, and maximum depth of growth are made. In addition Secchi depth and alkalinity data are collected.

This report identifies lakes and other waterbodies in Washington where invasive exotic aquatic plants were discovered since 1994 (Table 8). In addition, the type of aquatic plant found is identified by its common name.

Table 8. Location of Invasive Exotic Aquatic Weeds Identified.

County	Waterbody Name	Scientific name	Common name	Location
Adams	Hutchinson Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	16N-28E-15
Chelan	Chelan Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	27N-22E-13
Chelan	Cortez (Three) Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	22N-21E-29
Chelan	Domke Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	31N-18E-22
Chelan	Roses (Alkali) Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	28N-21E-26
Chelan	Wapato Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	28N-21E-23
Clallam	Sutherland Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	30N-08W-22
Clallam	Unnamed Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	30N-04W-17
Clark	Battleground Lake	*Egeria densa*	Brazilian elodea	04N-03E-30
Clark	Caterpillar Slough	*Myriophyllum spicatum*	Eurasian water-milfoil	03N-01W-36
Clark	Columbia River at Ridgefield	*Myriophyllum spicatum*	Eurasian water-milfoil	04N-01W-24
Clark	Klineline Pond	*Egeria densa*	Brazilian elodea	03N-01E-26
Clark	Lacamas Lake	*Egeria densa*	Brazilian elodea	01N-03E-02
Clatsop	Columbia River at Astoria	*Myriophyllum spicatum*	Eurasian water-milfoil	08N-08W-18
Columbia	Snake River at Little Goose Dam	*Myriophyllum spicatum*	Eurasian water-milfoil	13N-38E-26
Columbia	Snake River near Lyons Ferry	*Myriophyllum spicatum*	Eurasian water-milfoil	13N-37E-30
Cowlitz	Kress Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	07N-01W-31
Cowlitz	Silver Lake	*Egeria densa*	Brazilian elodea	10N-01W-36
Cowlitz	Solo Slough	*Cabomba caroliniana*	fanwort	08N-03W-14
Cowlitz	Solo Slough	*Egeria densa*	Brazilian elodea	08N-03W-14
Cowlitz	Solo Slough	*Ludwigia hexapetala*	water primrose	08N-03W-14
Cowlitz	Solo Slough	*Myriophyllum aquaticum*	parrotfeather	08N-03W-14
Cowlitz	Willow Grove Slough	*Cabomba caroliniana*	fanwort	08N-03W-14
Cowlitz	Willow Grove Slough	*Egeria densa*	Brazilian elodea	08N-03W-14
Cowlitz	Willow Grove Slough	*Myriophyllum spicatum*	Eurasian water-milfoil	08N-03W-14
Franklin	Scooteney Reservoir	*Myriophyllum spicatum*	Eurasian water-milfoil	14N-30E-27
Franklin	Snake River at Ice Harbor Dam	*Myriophyllum spicatum*	Eurasian water-milfoil	09N-31E-24
Franklin	Snake River at Lower Monumental Dam	*Myriophyllum spicatum*	Eurasian water-milfoil	13N-34E-34
Franklin	Snake River at Lyons Ferry	*Myriophyllum spicatum*	Eurasian water-milfoil	13N-37E-19
Grant	Babcock Ridge Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	20N-23E-10
Grant	Banks Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	25N-28E-33
Grant	Billy Clapp Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	23N-28E-36
Grant	Burke Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	19N-23E-23
Grant	Caliche Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	18N-23E-22
Grant	Evergreen Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	19N-23E-22
Grant	Moses Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	18N-28E-09
Grant	Potholes Reservoir	*Myriophyllum spicatum*	Eurasian water-milfoil	17N-28E-11
Grant	Priest Rapids Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	14N-23E-16
Grant	Red Rock Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	16N-26E-17

County	Waterbody Name	Scientific name	Common name	Location
Grant	Stan Coffin Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	19N-23E-10
Grant	Winchester Wasteway	*Myriophyllum spicatum*	Eurasian water-milfoil	19N-25E-25
Grant	Winchester Wasteway Ext.	*Myriophyllum spicatum*	Eurasian water-milfoil	18N-26E-25
Grays Harbor	Chehalis River	*Myriophyllum aquaticum*	parrotfeather	17N-06W-02
Grays Harbor	Connor Creek	*Myriophyllum spicatum*	Eurasian water-milfoil	18N-12W-03
Grays Harbor	Duck Lake	*Egeria densa*	Brazilian elodea	17N-12W-14
Grays Harbor	Duck Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	17N-12W-14
Island	Goss Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	29N-03E-06
Island	Lone Lake	*Egeria densa*	Brazilian elodea	29N-03E-07
Island	Unnamed Pond	*Egeria densa*	Brazilian elodea	30N-03E-32
Island	Unnamed Pond	*Myriophyllum aquaticum*	parrotfeather	32N-02E-35
Jefferson	Leland Lake	*Egeria densa*	Brazilian elodea	28N-02W-26
King	Bass Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	20N-06E-02
King	Desire Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	23N-05E-36
King	Dolloff Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	21N-04E-10
King	Dolloff Lake	*Egeria densa*	Brazilian elodea	21N-04E-10
King	Fenwick Lake	*Egeria densa*	Brazilian elodea	22N-04E-26
King	Geneva Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	21N-04E-22
King	Green Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	25N-04E-05
King	Lucerne Lake	*Hydrilla verticillata*	hydrilla	22N-06E-28
King	Lucerne Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	22N-06E-28
King	Meridian Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	22N-05E-27
King	Neilson (Holm) Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	21N-05E-14
King	Number Twelve Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	21N-06E-12
King	Otter (Spring) Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	23N-06E-31
King	Phantom Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	24N-05E-02
King	Pipe Lake	*Hydrilla verticillata*	hydrilla	22N-06E-28
King	Pipe Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	22N-06E-28
King	Sammamish Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	25N-04E-13
King	Sammamish Lake	*Egeria densa*	Brazilian elodea	25N-04E-13
King	Sawyer Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	21N-06E-04
King	Shadow Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	22N-06E-07
King	Shady Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	22N-05E-01
King	Ship Canal	*Myriophyllum spicatum*	Eurasian water-milfoil	25N-3E-13
King	Star Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	22N-04E-34
King	Steel Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	21N-04E-09
King	Union Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	25N-04E-19
King	Unnamed Pond	*Myriophyllum aquaticum*	parrotfeather	24N-05E-11
King	Washington Lake	*Egeria densa*	Brazilian elodea	25N-04E-16
King	Washington Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	25N-04E-16
King	Wilderness Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	22N-06E-27
Kitsap	Long Lake	*Egeria densa*	Brazilian elodea	23N-02E-17
Kitsap	Long Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	23N-02E-17
Kittitas	Fiorito Ponds	*Myriophyllum spicatum*	Eurasian water-milfoil	17N-19E-30
Kittitas	Lavender Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	20N-14E-20

County	Waterbody Name	Scientific name	Common name	Location
Kittitas	Mattoon Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	17N-18E-11
Kittitas	Private Pond (20N-16E-10)	*Myriophyllum spicatum*	Eurasian water-milfoil	20N-16E-10
Klickitat	Columbia River at Bingen	*Myriophyllum spicatum*	Eurasian water-milfoil	03N-11E-32
Klickitat	Columbia River at Maryhill	*Myriophyllum spicatum*	Eurasian water-milfoil	02N-15E-14
Klickitat	Horsethief Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	02N-14E-19
Lewis	Carlisle Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	13N-01E-30
Lewis	Chehalis River	*Egeria densa*	Brazilian elodea	14N-03W-02
Lewis	Chehalis River	*Myriophyllum aquaticum*	parrotfeather	14N-03W-02
Lewis	Cowlitz River near Blue Cr	*Myriophyllum spicatum*	Eurasian water-milfoil	11N-01E-01
Lewis	Interstate Ave Slough	*Myriophyllum aquaticum*	parrotfeather	14N-02W-32
Lewis	Mayfield Reservoir	*Myriophyllum spicatum*	Eurasian water-milfoil	12N-02E-29
Lewis	Plummer Lake	*Egeria densa*	Brazilian elodea	14N-02W-07
Lewis	Riffe Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	12N-03E-10
Lewis	South County Park Pond	*Myriophyllum spicatum*	Eurasian water-milfoil	11N-01W-17
Lewis	Swofford Pond	*Myriophyllum spicatum*	Eurasian water-milfoil	12N-03E-26
Mason	Island Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	20N-03W-06
Mason	Limerick Lake	*Egeria densa*	Brazilian elodea	21N-03W-27
Mason	Mason Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	22N-02W-34
Okanogan	Conconully (Salmon) Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	35N-25E-06
Okanogan	Conconully Reservoir	*Myriophyllum spicatum*	Eurasian water-milfoil	35N-25E-18
Okanogan	Osoyoos Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	40N-27E-22
Okanogan	Palmer Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	39N-25E-11
Okanogan	Rat Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	31N-24E-22
Okanogan	Whitestone Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	38N-27E-17
Pacific	Black Lake	*Egeria densa*	Brazilian elodea	10N-11W-28
Pacific	Black Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	10N-11W-28
Pacific	Loomis Lake	*Egeria densa*	Brazilian elodea	11N-11W-21
Pacific	Loomis Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	11N-11W-21
Pacific	Sloughs near Long Beach	*Myriophyllum aquaticum*	parrotfeather	10N-11W
Pend Oreille	Davis Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	32N-44E-31
Pend Oreille	Diamond Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	30N-44E-03
Pend Oreille	Fan Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	30N-43E-32
Pend Oreille	Horseshoe Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	30N-43E-08
Pend Oreille	Little Spokane River	*Myriophyllum spicatum*	Eurasian water-milfoil	56N-43E-34
Pend Oreille	Marshall Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	32N-45E-23
Pend Oreille	Nile Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	37N-42E-35
Pend Oreille	Pend Oreille River	*Myriophyllum spicatum*	Eurasian water-milfoil	38N-43E-32
Pend Oreille	Sacheen Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	31N-43E-35
Pierce	Clear Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	17N-04E-27
Pierce	Harts Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	16N-03E-07

County	Waterbody Name	Scientific name	Common name	Location
Pierce	Hidden Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	20N-05E-20
Pierce	Ohop Lake	*Egeria densa*	Brazilian elodea	16N-04E-10
Pierce	Slough, Port of Tacoma	*Myriophyllum aquaticum*	parrotfeather	20N-03E-02
Pierce	Tapps Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	20N-05E-08
Skagit	Beaver Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	34N-05E-07
Skagit	Big Lake	*Egeria densa*	Brazilian elodea	34N-04E-36
Skagit	Big Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	34N-04E-36
Skagit	Campbell Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	34N-01E-13
Skagit	Clear Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	34N-05E-07
Skagit	Erie Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	34N-01E-11
Skagit	Heart Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	35N-01E-36
Skagit	McMurray Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	33N-05E-30
Skagit	Sixteen Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	33N-04E-15
Skamania	Drano Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	03N-09E-26
Skamania	Coldwater Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	10N-05E-31
Snohomish	Goodwin Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	31N-04E-33
Snohomish	Meadow Lake	*Hydrocharis morsus-ranae*	European frog-bit	28N-07E-18
Snohomish	Nina Lake	*Myriophyllum aquaticum*	parrotfeather	31N-05E-32
Snohomish	Roesiger Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	29N-07E-28
Snohomish	Shoecraft Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	31N-04E-33
Snohomish	Silver Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	28N-05E-30
Snohomish	Stevens Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	29N-06E-08
Snohomish	Swartz Lake	*Egeria densa*	Brazilian elodea	30N-07E-20
Spokane	Eloika Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	29N-43E-15
Spokane	Liberty Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	25N-42E-22
Spokane	Long Lake (Reservoir)	*Myriophyllum spicatum*	Eurasian water-milfoil	27N-39E-13
Spokane	Long Lake (Reservoir)	*Nymphoides peltata*	water fringe	27N-39E-13
Spokane	Newman Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	26N-42E-10
Spokane	North Silver Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	24N-41E-17
Spokane	Silver Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	24N-41E-32
Stevens	Black Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	35N-41E-03
Stevens	Gillette Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	36N-42E-20
Stevens	Heritage Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	36N-42E-08
Stevens	Loon Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	30N-41E-33
Stevens	McDowell Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	34N-41E-06
Stevens	Sherry Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	36N-42E-20
Stevens	Thomas Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	36N-42E-18
Thurston	Capitol Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	18N-02W-15
Thurston	Deep Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	16N-02W-03
Thurston	Lois Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	18N-01W-15
Thurston	Long Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	18N-01W-22
Thurston	Nisqually River	*Egeria densa*	Brazilian elodea	18N-01E-05
Thurston	Scott Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	17N-02W-33
Thurston	Skiview Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	17N-02W-08

County	Waterbody Name	Scientific name	Common name	Location
Wahkiakum	Brooks Slough	*Myriophyllum aquaticum*	parrotfeather	09N-06W-26
Wahkiakum	Columbia River at Cathlamet	*Myriophyllum spicatum*	Eurasian water-milfoil	08N-06W-02
Wahkiakum	Columbia River at Skamokawa	*Myriophyllum aquaticum*	parrotfeather	09N-06W-18
Wahkiakum	Puget Island Sloughs	*Egeria densa*	Brazilian elodea	08N-06W-14
Wahkiakum	Puget Island Sloughs	*Myriophyllum aquaticum*	parrotfeather	08N-06W-14
Walla Walla	Snake River at Ice Harbor Dam	*Myriophyllum spicatum*	Eurasian water-milfoil	09N-31E-24
Walla Walla	Snake River at Lower Monumental Dam - Walla Walla	*Myriophyllum spicatum*	Eurasian water-milfoil	13N-34E-34
Whatcom	Whatcom Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	38N-03E-28
Whitman	Snake River at Central Ferry	*Myriophyllum spicatum*	Eurasian water-milfoil	13N-40E-08
Whitman	Snake River at Little Goose Dam	*Myriophyllum spicatum*	Eurasian water-milfoil	13N-38E-23
Whitman	Snake River at Lower Granite Dam	*Myriophyllum spicatum*	Eurasian water-milfoil	13N-43E-12
Yakima	Buena Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	11N-20E-21
Yakima	Byron Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	08N-23E-12
Yakima	Dog Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	14N-12E-31
Yakima	Freeway (Rotary) Lake	*Myriophyllum spicatum*	Eurasian water-milfoil	13N-19E-07
Yakima	I-82 Pond, Exit 50	*Myriophyllum aquaticum*	parrotfeather	11N-20E-28
Yakima	I-82 Ponds, Exit 52	*Myriophyllum aquaticum*	parrotfeather	11N-20E-35
Yakima	Pond 2	*Myriophyllum spicatum*	Eurasian water-milfoil	12N-19E-35
Yakima	Pond 3	*Myriophyllum spicatum*	Eurasian water-milfoil	11N-19E-01
Yakima	Pond 4	*Myriophyllum spicatum*	Eurasian water-milfoil	11N-20E-17
Yakima	Pond 5	*Myriophyllum spicatum*	Eurasian water-milfoil	11N-20E-20
Yakima	Unnamed Ponds	*Myriophyllum spicatum*	Eurasian water-milfoil	12N-19E-20

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