

## **CHAPTER 5. WATER QUALITY**

### **5.1 EXISTING WATER QUALITY DATA**

The detailed listings of the Washington Department of Ecology's 1998 and 1994 *Washington State Water Quality Assessment; Section 305(b) Reports* were used to review beneficial uses and impairments of Boise Creek. The 1998 *303(d) List of Impaired and Threatened Waterbodies* is the current list for water quality impairment status. Ecology was contacted for information on the stream classification of Boise Creek. Boise Creek is a tributary of the White River, which Ecology has identified as a watershed of concern. The White and Puyallup Rivers and their tributaries have been experiencing declining flows due to growth pressure and increased demand for water.

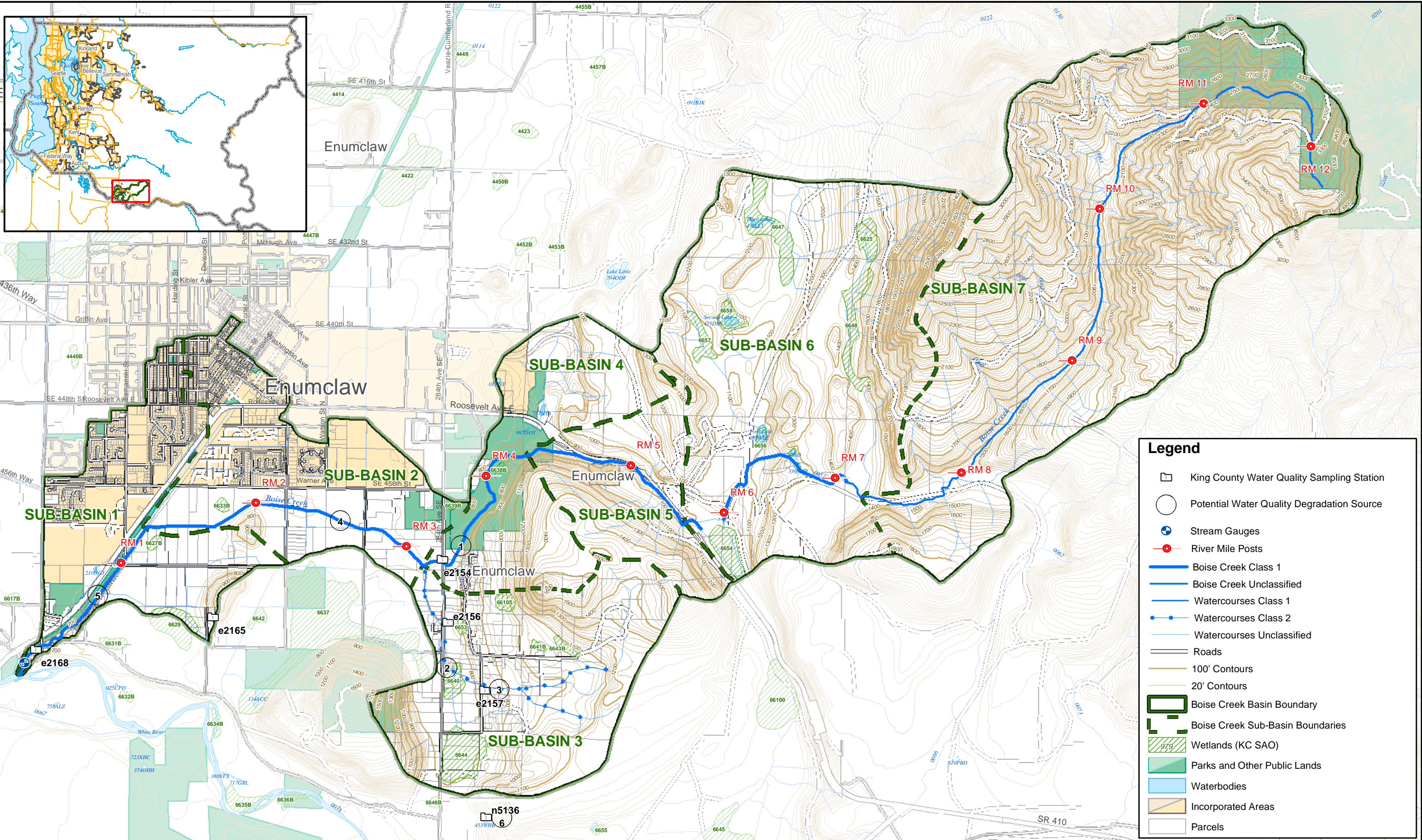
Data from six King County sampling stations and one USGS sampling station were available for review of water quality in the Boise Creek Basin. The gauging stations are shown in Figure 5-1. Station E2165 is just outside the basin, but its results are included with this review due to its proximity to Boise Creek. The USGS sampling station was located at Buckley, at the lower portion of the Boise Creek basin. Station E2168 is the nearest King County sampling station to the USGS station. The other King County stations are located more centrally in the basin. Some data from two Ecology sampling stations at Buckley (RM 0.1) and Enumclaw (RM 6.5) were also reviewed.

#### **5.1.1 Water Quality Standards**

Boise Creek is classified as a Class A freshwater stream under Washington Administrative Code (WAC) 173-201A. Table 5-1 lists water quality standards that apply to Class A waters. Characteristic uses for Class A streams include the following:

- Water supply
- Stock watering
- Fish and shellfish habitat, fishery, and migration
- Recreation
- Commerce and navigation.

State water quality standards may change in the near future. The Department of Ecology issued a final rule on July 1, 2003, but the U.S. Environmental Protection Agency and other federal agencies must approve the rule before it becomes effective, which is anticipated in early 2004. It does not appear that the changes in standards would materially affect conclusions about water quality in the Boise Creek Basin. It may be desirable to update the water quality review after final adoption of the proposed new standards and the gathering of additional data.

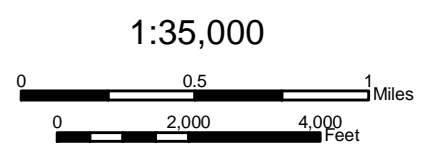


**Legend**

- King County Water Quality Sampling Station
- Potential Water Quality Degradation Source
- Stream Gauges
- River Mile Posts
- Boise Creek Class 1
- Boise Creek Unclassified
- Watercourses Class 1
- Watercourses Class 2
- Watercourses Unclassified
- Roads
- 100' Contours
- 20' Contours
- Boise Creek Basin Boundary
- Boise Creek Sub-Basin Boundaries
- Wetlands (KC SAO)
- Parks and Other Public Lands
- Waterbodies
- Incorporated Areas
- Parcels

Map prepared for King County by Adolfsen Associates, Inc. The map data shown are the property of the sources listed below. Inaccuracies may exist, and Adolfsen Associates, Inc. implies no warranties or guarantees regarding any aspect of data depiction.

Source:  
King County GIS, 2002; WSDOT 2002; WDNR



**BOISE CREEK BASIN - WATER QUALITY**  
**KING COUNTY RAPID RURAL RECONNAISSANCE**  
 Figure 5-1

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TABLE 5-1.  
CLASS A CRITERIA FOR FRESHWATER STREAMS

Water Quality Parameter	Requirement
Fecal coliform	Shall not exceed a geometric mean value of 100 colonies/100 ml, and shall not have more than 10% of all samples obtained for calculating the geometric mean value exceeding 200 colonies/100 ml.
Dissolved Oxygen (DO)	Shall exceed 8.0 mg/L
Total Dissolved Gas	Shall not exceed 110 percent of saturation
Temperature	Shall not exceed 18.0°C due to human activities. When natural conditions exceed 18.0°C, no activities will be allowed that increase water temperature by more than 0.3°C.
PH	6.5 to 8.5, with human-caused variation of less than 0.2 units
Turbidity	Shall not exceed 5 NTU (nephelometric turbidity units) over background when background is 50 NTU or less, or have more than a 10% increase in turbidity when the background turbidity is more than 50 NTU.
Toxic, Radioactive or Deleterious Materials	Specific criteria per WAC 173-201A-(040-050)
Aesthetic Values	Shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

Source: Chapter 173-201A WAC

Under the proposed new rules, the Boise Creek Basin is designated for salmon spawning and rearing aquatic use, all primary contact uses, all water supply uses, and all other miscellaneous uses, as an undesignated tributary of the White River. Freshwater salmon spawning and rearing requirements are more stringent than the Class A requirements with respect to the standard for dissolved oxygen (the minimum concentration is 9.5 mg/L, with a one-day minimum of 7 mg/L) and temperature (the maximum is 16°C).

Water supply uses include agriculture, which has a conductivity standard (not to exceed 700 microsiemens per centimeter). Data on specific conductance was available but is not reported in this chapter since some of the measurements were inconsistent, and the criteria for specific conductance in WAC 173-201A are not yet effective. Generally, high specific conductance indicates the presence of salts or other materials from natural or manmade sources, or tidal influence.

The proposed new standard for total suspended solids (TSS) is be 75 mg/L. TSS measurements were not undertaken by King County. Ecology’s data collected at Buckley do not reveal any exceedances for suspended solids. No information was available from any of the sources reviewed on aesthetics, or toxic, radioactive, or deleterious materials.

Ecology provides a Water Quality Index (WQI) based on monitoring done by Ecology’s Stream Monitoring Unit. The WQI may not be consistent with Ecology’s 303(d) listing

(discussed below) because of the use of different data sources in preparation of the WQI and the 303(d) list. Based on the water year 2001 assessment, the overall water quality at the Buckley station was of moderate concern.

A segment of Boise Creek, upstream of Mill Pond, is listed as a 303(d) impaired water body for temperature, according to the 1998 303(d) list. Ecology based the listing on data collected by staff of the Muckleshoot Indian Tribe, which showed multiple excursions beyond the criterion during 1992. The 1998 303(d) worksheet indicated that a total maximum daily load (TMDL) study is needed for Boise Creek. Salmonid spawning was listed as an impaired use, with thermal modifications listed as the cause. Specific thermal modifications were not given, but could include removal of bank tree cover and other land cover changes.

A draft 2002/2004 303(d) list includes segments of Boise Creek as water quality impaired for fecal coliform (near the junction with the White River), pH (at the junction of the main stem and south fork), and temperature (main stem, upstream of Mill Pond), and requiring a TMDL. The draft list is in a public review period from January 15 to March 15, 2004, and is subject to change.

### **5.1.2 Water Quality Sampling Data**

Table 5-2 summarizes the data from King County and other sampling stations. Sampling observation periods varied from one to four years among the King County stations. Sampling station E2165, which is near the Boise Creek basin boundary in a flat agricultural area, encountered occasional dry conditions, and results in Table 5-2 provide flow-based results for comparison with the total results.

No sampling data were available for upper parts of the Boise Creek Basin. The upper basin is largely forested, and little impairment from activities such as urban development or agriculture is anticipated. There may be some effect from activities or conditions such as forestry, natural erosion, limited development, and roads, to the extent that they exist in the upper watershed. Stations in the Boise Creek basin include E2168 (approx. RM 0.1), E2154 (approx. RM 3.3, along main stem), E2156 (south fork, approx. RM 0.4), and E2157 (south fork, approx. RM 0.9). As noted above, station E2165 is appears to be outside the Boise Creek basin, but is very near the basin drainage divide at SE 472nd St. and 260th Ave. SE, in a relatively flat area. Because it may indicate boundary conditions, data from station E2165 is included in this review.

Stations E2154 and E2168 generally met criteria for pH, DO, and temperature, although temperatures came close to maximum levels. Average turbidity was relatively low, at 4.3 and 6.7 NTU (nephelometric turbidity units), respectively. But many incidences of higher turbidity occurred, with some significant peaks (36.4 and 55.1 NTU), generally associated with periods of rainfall.

Stations E2156 and E2165 had minimum pH readings below the 6.5 lower limit during flow conditions, even allowing 0.2 units for human activities. Stations E2154 and E2157 had minimums at or near the 6.5 lower limit.

Dissolved oxygen minimums were below 8.0 mg/L at four of the seven sampling stations. Station E2165 had an average DO of 6.4 mg/L during flowing conditions, which was well below the standard. Station E2165 experienced periodic dry conditions, which occurred in August and September in each year of monitoring, from 1999 to 2002. In 2002, a dry condition was also observed at Station E2165 in late October.

Average temperatures were below the standard of 18°C, but maximum temperatures exceeded the limit at stations E2156 (18.2°C), E2157 (18.3°C), and E2165 (19.5°C). Station E2168 had a maximum at the limit of 18.0° in August of 2000, and the USGS station was near the limit with a maximum of 17.8 in July of 1973.

Scatter plots included in Appendix D show the seasonality of water temperature and other parameters associated with seasonal heating and rainfall, such as DO and turbidity. The temperature effects can also be attributed to reduced land cover due to agriculture, open areas such as the golf course, urban development, and riparian alteration. Turbidity can be attributed to agricultural activity, erosion-prone areas, and construction activity.

For average conditions, turbidity was relatively high at E2165 under flow conditions (mean 9.0 NTU). Most locations occasionally showed higher turbidity, sometimes significantly so, during rainy conditions.

TABLE 5-2.  
BOISE CREEK BASIN SAMPLING SITES

SITE	Approx. River Mile (RM)	pH (6.5-8.5 <sup>a</sup> )	DO (mg/L) (A>8.0, SS>9.5 <sup>b</sup> )	Water Temperature (°C, A<=18° SS <=16° <sup>a</sup> )	Turbidity (NTU, <=5 NTU over existing <sup>a</sup> ) <sup>c</sup>	Fecal Coliform (colonies/100 ml <sup>a</sup> )
E2168	Main stem,					
Mean	RM 0.1	7.6	11.4	9.9	6.7	NA
Maximum		8.2	15.2	18.0	55.1	NA
Minimum		6.9	8.4	2.3	0.0	NA
E2154	RM 3.3,					
Mean	along main	7.6	11.3	9.7	4.3	NA
Maximum	stem	8.2	13.1	16.8	36.4	NA
Minimum		6.5	8.5	3.2	0.0	NA
E2156	South fork,					
Mean	RM 0.4	7.3	9.7	10.4	5.1	NA
Maximum		8.0	12.5	18.2	39.4	NA
Minimum		6.2	2.6	1.9	0.0	NA
E2157	South fork,					
Mean	RM 0.9	7.5	11.0	9.6	4.1	NA
Maximum		8.0	13.3	18.3	14.1	NA
Minimum		6.6	6.5	2.4	0.0	NA
E2165 (Near basin boundary) <sup>c</sup>	NA					
Mean		4.7	4.4	6.5	6.3	NA
Maximum		7.7	11.1	19.5	93.4	NA
Minimum <sup>b</sup>		-1.0	-1.0	-1.0	-1.0	NA
E2165 (Near basin boundary, Wet only) <sup>c</sup>	NA					
Mean		6.8	6.4	9.3	9.0	NA
Maximum		7.7	11.1	19.5	93.4	NA
Minimum		5.7	0.5	1.9	0.0	NA
Ecology 10D070 (Buckley)	Main stem, RM 0.1					
Mean <sup>e</sup>		7.7	11.1	9.6	NA	96
Maximum		8.0	14.1	16.6	NA	1,200
Minimum		7.3	9.5	1.0	NA	15
90th Percentile <sup>f</sup>						628
Ecology 10D090 (Enumclaw)	Main stem, RM 6.5					
Mean		7.0	11.2	6.7	0.7	NA
Maximum		7.2	12.4	11.0	5.0	NA
Minimum		6.8	10.2	3.0	0.1	NA

TABLE 5-2.  
BOISE CREEK BASIN SAMPLING SITES

USGS 12099600 (Buckley)	NA					
Mean		7.6	11.3	10.2	<i>g</i>	NA
Maximum		9.0	20.0	17.8	<i>g</i>	NA
Minimum		7.0	8.5	0.2	<i>g</i>	NA
<p>a. Freshwater salmon spawning and rearing requirements (SS) would be more stringent than the Class A (A) requirements in the standard for dissolved oxygen (the proposed minimum concentration is 9.5 mg/L, with a one-day minimum of 7 mg/L) and temperature (the proposed maximum is 16°C). Standard is unchanged from Class A requirement for pH and turbidity Variance allowed for human causes: pH: 0.2, temperature: 0.3° over natural temperature if natural temperature is over 16°.</p> <p>b. -1.0 minimum measurement indicates dry condition in some measurements.</p> <p>c. Station may be located outside basin.</p> <p>d. NTU = nephelometric turbidity units</p> <p>e. Geometric mean</p> <p>f. Percentile values for fecal coliform only</p> <p>g. Measurements were in different units.</p> <p>NA—Not Available</p>						

Elevated fecal coliform was observed at the Ecology station at Buckley. The geometric mean was 96 colonies per 100 ml. The 90th-percentile value was 628 colonies per 100 ml. Therefore, while the geometric mean met the 100 colonies per 100 ml standard, more than 10 percent of the measurements were above 200 colonies per 100 ml. The actual number of measurements over 200 colonies per 100 ml was 4 out of 12 (33%).

The pH readings indicate occasional failures to meet minimum pH levels at several King County stations, and exceedances of the maximum pH level at the USGS station at Buckley. Minima at E2154, E2156, and E2165 equaled or went below the 6.5 minimum (including the 0.2 variance for human activity, the threshold lowers to 6.3).

Additional evaluation was conducted on biological integrity as part of the habitat review described in Section 6. Evaluations ranged from fair to poor for the stations where data was reported (E2154, E2168).

## 5.2 POTENTIAL POLLUTANT SOURCES

Materials reviewed to identify potential pollutant sources included King County aerial photographs; zoning, land cover and sensitive areas map data; and Ecology’s water quality data. Nearby conditions that could affect surface water quality are listed in Table 5-3 and indicated on Figure 5-1. Other possible causes of turbidity and pollutants include first-flush runoff and erosion hazard areas. In addition to the information in Table 5-3, thermal modifications were indicated by Ecology for the 303(d) listing for temperature in 1998.

TABLE 5-3.  
POTENTIAL WATER QUALITY DEGRADATION SOURCES

Station	Approx. River Mile	Nearby Conditions/Potential Sources
E2168	Main Stem, RM 0.1	Mixture of agricultural and urban areas, some bare soil in upstream locations. The sampling station is near or within an erosion hazard area.
E2154	Main stem, RM 3.3	Agricultural areas with areas of bare soil, locations, in and near the golf course, and channel erosion
E2156	South fork, RM. 0.4	Rural residential/agricultural area and mixed urban/low density. The sampling station is near or within an erosion hazard area.
E2157	South fork, RM 0.9	Rural residential/agricultural areas of bare soil and some mixed urban/low density areas. The sampling station is near or within an erosion hazard area.
E2165 <sup>a</sup>	NA	Rural agricultural areas

a. Station appears to be located outside the Boise Creek drainage basin, but is near the drainage divide at SE 472nd St. and 260th Ave. SE, and slopes are relatively flat in this area.

### 5.3 CONCLUSIONS

Boise Creek has impaired water quality requiring remedial action. The most significant water quality problem, for which Boise Creek is currently 303(d)-listed, is high water temperatures that approach and exceed Class A thresholds at four of the six King County stations (E2156, E21587, E2165, E2168). Lower DO levels tend to occur with higher temperatures, and this is the case with three of the four stations with high temperatures (E2156, E2157, E2165).

Water quality upstream from many of these stations appears to be affected by agricultural activities and to a lesser extent by urban development. The proximity of the golf course is also a potentially significant condition for station E2154. The relative lack of tree canopy and overhanging vegetative cover within the golf course allows for greater thermal effect on runoff, and hence increased temperatures and lower DO. Low DO may also occur in connection with biological oxygen demand (BOD) or chemical oxygen demand (COD); however BOD and COD data were not available. The thermal and DO problems impair salmonid spawning in Boise Creek, and may cause other habitat problems.

The pH readings indicate occasional failures to meet minimum pH levels at several King County stations, and exceedances of the maximum pH level at the USGS station at Buckley. These pH problems may be caused by use of chemicals such as deicers (alkalinity), fertilizers (alkalinity), agricultural production (acidity), or natural causes from organic matter (acidity) and minerals (acidity or alkalinity). In view of the mostly



rural conditions in the Boise Creek subbasin, agricultural production and natural sources are likely potential factors in these pH variances.

There were insufficient fecal coliform data stations to form general conclusions. However, the high levels at the Ecology station in Buckley may indicate agricultural and/or domestic sources such as failing septic tanks.

The above water quality problems are further underscored by the proposed 2002/2004 303(d) listing status for Boise Creek, for pH, temperature, and fecal coliform.

#### **5.4 RECOMMENDATIONS FOR ACTION AND SAMPLING**

Additional sampling is recommended for nutrients, fecal coliform, and other relevant parameters aimed at detecting agriculture and open space management problems.

Also recommended is an evaluation of the potential for riparian vegetation protection and restoration projects to improve temperature and dissolved oxygen conditions for salmonid habitat. For example, several previous studies on Boise Creek have considered means of solving flooding along the golf course and enhancing fish habitat. As a result of one study, one of the cart path bridges was removed and several were modified to provide additional flow depth under the bridge spans. Other projects proposed in previous studies have been completed upstream to help reduce erosion. However, some erosion still occurs.

The reach of Boise Creek within the golf course is an important chinook spawning area. The lack of a riparian buffer through much of the golf course reach deprives salmon and other aquatic organisms of many benefits that vegetative buffers provide: biofiltration, shade, cover, large woody debris recruitment, and habitat for terrestrial insect populations.

Potential channel relocation and riparian habitat protection measures should be implemented to increase vegetative cover, bank protection from livestock, and limit impervious area. It is also recommended that King County coordinate with the Department of Ecology on Ecology's current TMDL study and evaluation for the Upper White River Watershed.