Yamhill
Basin
Council

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March 29, 2005

To Whom It May Concern,

Accompanying this letter you will find a CD of the Yamhill Basin Council 2003-2004 Water Quality and Temperature Monitoring Reports. The data in this report was collected during the summers of 2003 and 2004, as part of the Yamhill Basin Water Quality Monitoring Project, a two-year effort to collect baseline data in the Yamhill River and Chehalem Creek watersheds. The results will help the YBC and partners, such as the Yamhill Soil and Water Conservation District, determine where to focus efforts to improve water quality as well as enhance fish and wildlife habitat.

Chemical, biological, and physical stream parameters were sampled and measured for this project. Parameters monitored included temperature, dissolved oxygen, turbidity, pH, conductivity, *E. coli* and benthic macroinvertebrates (aquatic insects, a good indicator of water quality). The full report includes background information, scientific methods, state standards, and a discussion of the results is also available on the web at http://www.co.yamhill.or.us/ybc.

This project was made possible through a grant from the Oregon Watershed Enhancement Board and additional support from the Oregon Department of Agriculture, Oregon Department of Environmental Quality, McMinnville Water Reclamation Facility, and the Yamhill Soil and Water Conservation District. The participation of landowners, volunteers and other organizations was vital to the success of this project. The Yamhill Basin Council is dedicated to improving local watersheds by working collaboratively with private and public landowners and organizations. If you are interested in volunteering with the YBC please contact us at (503) 434-7447.

The Yamhill Basin Council has recently been awarded a grant from the Oregon Watershed Enhancement Board to continue the Temperature and Water Quality Monitoring Project for 2005-2007. Monitoring will focus on the North Yamhill Subwatershed and will include measuring stream flow. Thank you for your interest in the Yamhill Basin Council. We hope you find the report interesting as well as educational. Please feel free to share this with your family, friends and colleagues!

Sincerely,

Patricia Farrell
Chair
Yamhill Basin Council

Yamhill Basin Council

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Press Release

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February 1, 2005

Yamhill Basin Council Announces the Completion of the 2003-2004 Water Quality Monitoring Project Final Report.

The Yamhill Basin Council (YBC) is pleased to announce the completion of the 2003-2004 Water Quality Monitoring Project Final Report. The Water Quality Monitoring Project collected water quality data in the Yamhill River and Chehalem Creek watersheds. Streams monitored included Willamina Creek, Mill Creek, Deer Creek, Salt Creek, Turner Creek and Chehalem Creek.

This YBC project was funded by the Oregon Watershed Enhancement Board. Additional support was provided by the Oregon Department of Agriculture, Oregon Department of Environmental Quality, McMinnville Water Reclamation Facility and the Yamhill Soil and Water Conservation District. Approximately 50 YBC members, volunteers, and partners donated more than 800 hours to the project.

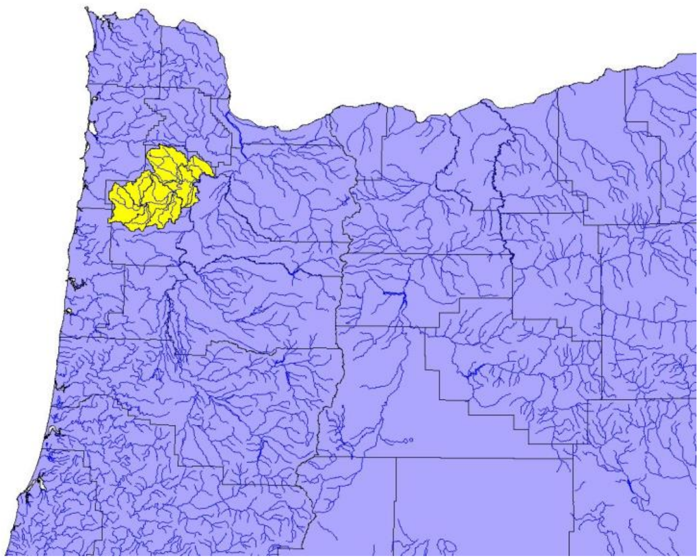
The YBC collected baseline water quality data on stream temperatures, dissolved oxygen, pH, turbidity and conductivity at 25 sites in 2003 and 15 sites in 2004 throughout the area. At some of these sites, the YBC sampled benthic macroinvertebrates (aquatic insects living in the bottom of streambeds) and *Escherichia coli*, a type of bacteria found in the solid waste of humans, domesticated animals, livestock and wildlife.

It is important to keep in mind that the data only represents two summers of sampling. Results for dissolved oxygen, turbidity, conductivity, *E. coli* and benthic macroinvertebrates were mixed, with some sites meeting state standards and guidelines and others not. For pH, all of the sites monitored met the state standard. However, almost all sites did not meet the state standard for stream temperature. Ways to improve water quality in the basin include reducing fertilizer use, building fences to reduce fecal contamination from pets and livestock, identifying and fixing leaking septic tanks, planting native trees and shrubs to provide shade and prevent erosion and implementing best management practices (BMP). BMPs include planting ditches to filter runoff, planting cover crops between rows to reduce erosion and building filter strips between fields and streams.

The full report will be available on the YBC website later this year at www.co.yamhill.or.us/ybc. It will include background information, methods used, results and site photos and a discussion of the results.

Please contact the Yamhill Basin Council at (503) 434-7447 for more information on the 2003-2004 Water Quality Monitoring Project Final Report or to volunteer with future monitoring projects.

Yamhill Basin Council



2003-2004 Water Quality Monitoring Final Report

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Acknowledgements

Funding for the Yamhill Basin Council Water Quality Monitoring Project was provided by the Oregon Watershed Enhancement Board (OWEB), Oregon Department of Agriculture and local matching funds.

This project would not have been possible without the many private landowners that provided access to the streams.

Thanks to the many people who collected data, processed samples, provided technical assistance and donated use of space or office machines. They include:

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Nickie Shell, Watershed resident
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Yamhill County
Yamhill Soil and Water Conservation District

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Abbreviations and Acronyms

AgWQMAP	Agricultural Water Quality Management Area Plan
B-IBI	Benthic Index of Biotic Integrity
BLM	Bureau of Land Management
BOD	Biological oxygen demand
CTGR	Confederated Tribes of Grand Ronde
Cfs	Cubic feet per second
DO	Dissolved oxygen
E. coli	*Escherichia coli*
GIS	Geographic Information System
GPS	Global Positioning System
L	liter
LAC	local advisory committee
mg	milligram
mL	milliliter
MPN	Most probable number
N	Normality
NRCS	Natural Resource Conservation Service
NTU	Nephlometric turbidity units
ODA	Oregon Department of Agriculture
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OWEB	Oregon Watershed Enhancement Board
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RM	River mile
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
WRF	McMinnville Water Reclamation Facility
WQMP	Water Quality Monitoring Project
YBC	Yamhill Basin Council

Chapter 1 – Executive Summary

Water quality in the Yamhill River and Chehalem Creek watersheds is influenced by both human activity and natural processes. In this region, a healthy water supply is vital to supporting domestic and industrial water usage, fish and wildlife, irrigation, recreation, and livestock watering.

Water quality is affected by a number of factors in the Yamhill Basin, including land use practices associated with urbanization, agriculture, and forest management. Human activities in our watersheds have decreased water quality, reduced habitat diversity for wildlife and sent populations of some aquatic species into decline. The Oregon Department of Environmental Quality (ODEQ) has placed several area streams on their 303(d) list, indicating that they are impaired.

The majority of water quality monitoring in the Yamhill River watershed has been conducted in the Coast Range, on lands managed by the federal government (Bureau of Land Management), the Confederated Tribes of Grand Ronde, and private industrial timberland owners. The McMinnville Water Reclamation Facility tests water quality on the South Yamhill River, upstream and downstream from the treatment plant.

In 1998, with the cooperation of private and public landowners, the Yamhill Basin Council (YBC) began to monitor stream temperature at a number of sites throughout the region. The purpose of this program was to collect baseline data on stream temperatures in areas not monitored by other parties.

In 2002, in accordance with the Council's action plan, the YBC decided to pursue monitoring additional water quality parameters to increase local knowledge of stream conditions. The YBC applied for a grant from the Oregon Watershed Enhancement Board and secured funding to monitor new parameters at sites throughout the basin in 2003 and 2004. The Yamhill Basin Water Quality Project was initiated in the summer of 2003 at 25 sites. In 2004, monitoring continued at a subset of the 2003 sites.

Chemical, biological, and physical stream parameters were sampled and measured. Parameters tested included temperature, dissolved oxygen, pH, conductivity, turbidity, *E. coli*, and benthic macroinvertebrates (aquatic insects, a good indicator of water quality). The significance of these parameters and summarized results may be found in Table 1.1. Tables 1.2 and 1.3 identify the parameters monitored at each site and whether or not that site met state water quality standards or guidelines. The full report, which will be available on the YBC website (www.co.yamhill.or.us/ybc) in 2005, will provide background information, scientific methods, state standards, and a discussion of the results.

The baseline data will help the YBC and partners, such as the Yamhill Soil and Water Conservation District, determine where best to focus efforts to improve water quality as well as fish and wildlife habitat. In addition, by collecting water quality data over several years, we may be able to determine which conservation practices provide the greatest benefit for water quality.

The Yamhill Basin Water Quality Monitoring Project was made possible through a grant from the Oregon Watershed Enhancement Board and additional support from the Oregon Department of Agriculture, Oregon Department of Environmental Quality, McMinnville Water Reclamation Facility, and the Yamhill Soil & Water Conservation District. The participation of landowners, volunteers, and other organizations was vital to the success of this project.

Table 1.1 Types of Baseline Data Collected and 2003-2004 Results.

Parameter	Importance	2003 Results[1]	2004 Results
Temperature	Affects metabolism, growth and survival of aquatic organisms	2 sites met the standard 22 sites exceeded the standard	1 site met the standard 23 sites exceeded the standard
Dissolved Oxygen	Necessary for salmonid survival High levels needed for fish eggs	13 sites met the standard 12 sites did not meet the standard	7 sites met the standard 8 sites did not meet the standard
Turbidity	High levels may clog gills and impair foraging of salmonids	10 sites met the guideline 15 sites exceeded the guideline	4 sites met the guideline 11 sites exceeded the guideline
pH	Extremes may affect fish egg and aquatic insect survival Extremes may affect toxicity of pollutants such as ammonia and heavy metals	25 sites met the standard 0 sites exceeded the standard	15 sites met the standard 0 sites exceeded the standard
Conductivity	High levels may indicate water pollution	15 sites met the guideline 10 sites exceeded the guideline	10 sites met the guideline 5 sites exceeded the guideline
E. coli	High levels indicate a health risk to humans High levels indicate nutrient loading to streams	6 sites met both standards 12 sites did not meet one or both standards	2 sites met both standards 14 sites did not meet one or both standards
Benthic Macroinvertebrates	Presence or absence of different species suggests level of stream impairment or disturbance	10 sites indicate slight impairment 3 sites indicate moderate impairment	3 sites indicate slight impairment 1 site indicates moderate impairment

[1] The original monitoring plan was to collect data on all parameters at 25 sites in 2003 and 14 sites in 2004. Due to budget limitations, *E. coli* and benthic macroinvertebrate samples were collected at fewer sites. For *E. coli* and benthic macroinvertebrate sampling, site selection was based on safety, site comparability, and stream flow. For 2004 monitoring, site selection was based on safety, stream flow and ability to represent each subwatershed.

Table 1.2 Summary of 2003-2004 Temperature, Dissolved Oxygen, Turbidity and pH Results.

Subwatershed	Site[2]	2003 Temperature 7-day avg	2004 Temperature 7-day avg	2003 Dissolved Oxygen	2004 Dissolved Oxygen	2003 Turbidity	2004Turbidity	2003 pH	2004 pH
STANDARD or	GUIDELINE →	< 64.4F[3]	< 64.4F	> 8 mg/L[4]	> 8 mg/L	< 3 NTU	< 3 NTU	6.5-8.5	6.5-8.5
Chehalem	Chehalem	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Met	Met
Chehalem	Spring Brook	Did not meet	Data lost	Did not meet	Did not meet	Did not meet	Did not meet	Met	Met
Lower South Yamhill	Upper Deer	Did not meet	Did not meet	Met	Met	Did not meet	Did not meet	Met	Met
Lower South Yamhill	Lower Deer	Did not meet	Did not meet	Did not meet		Did not meet		Met	
Lower South Yamhill	Muddy	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Met	Met
Lower Yamhill	Cozine	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Met	Met
Lower Yamhill	Palmer	Did not meet							
Mill	Upper Gooseneck	Met	Met	Did not meet		Did not meet		Met	
Mill	Middle Gooseneck	Did not meet	Did not meet	Did not meet	Did not meet	Met	Met	Met	Met
Mill	Lower Gooseneck	Did not meet	Did not meet	Did not meet		Met		Met	
Mill	Upper Mill	Did not meet	Did not meet	Met	Met	Met	Met	Met	Met
Mill	Lower Mill	Did not meet	Data lost	Met	Met	Met	Met	Met	Met
North Yamhill	Hay	Did not meet	Did not meet	Did not meet		Did not meet		Met	
North Yamhill	Wildwood	Met	Did not meet	Met	Met	Did not meet	Did not meet	Met	Met
North Yamhill	Hawn (went dry)	Did not meet	Did not meet	Did not meet		Did not meet		Met	
North Yamhill	Middle Turner	Did not meet	Did not meet	Met		Met		Met	
North Yamhill	Lower Turner	Did not meet	Did not meet	Met	Did not meet	Did not meet	Did not meet	Met	Met
North Yamhill	North Yamhill	Did not meet	Did not meet	Met	Met	Met	Met	Met	Met
North Yamhill	Panther	Did not meet	Did not meet	Met	Did not meet	Did not meet	Did not meet	Met	Met
North Yamhill	Baker								
Salt	Upper Salt	Did not meet	Did not meet	Met		Met		Met	
Salt	Middle Salt	Data Lost		Did not meet		Did not meet		Met	
Salt	Lower Salt	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Met	Met
Upper South Yamhill	Cosper	Did not meet	Did not meet	Met	Met	Did not meet	Did not meet	Met	Met
Willamina	East	Did not meet	Did not meet	Met		Met		Met	
Willamina	Coast	Did not meet	Did not meet	Met		Met		Met	
Willamina	Willamina	Did not meet	Did not meet	Met	Met	Met	Did not meet	Met	Met

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[2] Sites are organized upstream to downstream within each subwatershed.
[3] ODEQ standard for 303(d) listing is a 7 day average high over 64ºF.
[4] ODEQ standard for 303(d) listing is >10% samples measuring <8 mgO_2/L.

Table 1.3 Summary of 2003-2004 Conductivity, *E. coli* and Benthic Macroinvertebrate Results.

Subwatershed	Site[5]	2003 Conductivity	2004 Conductivity	2003 *E. coli* All samples	2004 *E. coli* All samples	2003 *E. coli* Geomean[6]	2004 *E. coli* Geomean	2003 Benthic Macroinvertebrates	2004 Benthic Macroinvertebrates
STANDARD or	GUIDELINE →	< 180 mhos/cm	< 180 mhos/cm	< 406cells[7]/100mL	< 406cells/100mL	< 126cells/100mL	< 126cells/100mL	B-IBI[8] values 10-50[9]	B-IBI values 10-50
Chehalem	Chehalem	Did not meet	Did not meet	Did not meet	Met	Did not meet	Met		
Chehalem	Spring Brook	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet		
Lower South Yamhill	Upper Deer	Met	Met	Did not meet				Slight impairment	
Lower South Yamhill	Lower Deer	Met		Did not meet	Did not meet		Did not meet		
Lower South Yamhill	Muddy	Did not meet	Did not meet		Did not meet		Did not meet		
Lower Yamhill	Cozine	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet		
Lower Yamhill	Palmer								
Mill	Upper Gooseneck	Met							
Mill	Middle Gooseneck	Met	Met	Met	Met	Met		Moderate impairment	Slight impairment
Mill	Lower Gooseneck	Did not meet		Did not meet		Met			
Mill	Upper Mill	Met	Met	Met		Met		Slight impairment	
Mill	Lower Mill	Met	Met	Met	Did not meet	Met		Moderate impairment	Slight impairment
North Yamhill	Hay	Did not meet						Slight impairment	
North Yamhill	Wildwood	Met	Met		Did not meet		Did not meet	Slight impairment	
North Yamhill	Hawn (went dry)	Did not meet							
North Yamhill	Middle Turner	Met		Did not meet	Did not meet	Did not meet		Slight impairment	
North Yamhill	Lower Turner	Met	Met	Did not meet	Met	Did not meet		Moderate impairment	
North Yamhill	North Yamhill	Met	Met	Did not meet	Did not meet	Did not meet		Slight impairment	
North Yamhill	Panther	Did not meet	Met	Did not meet	Did not meet	Did not meet	Did not meet		Moderate impairment
North Yamhill	Baker								Slight impairment
Salt	Upper Salt	Met							
Salt	Middle Salt	Did not meet							
Salt	Lower Salt	Did not meet	Did not meet	Met		Met			
Upper South Yamhill	Cosper	Met	Met	Did not meet	Did not meet	Did not meet	Did not meet	Slight impairment	
Willamina	East	Met		Met	Met	Met	Met	Slight impairment	
Willamina	Coast	Met		Met	Met	Met	Did not meet	Slight impairment	
Willamina	Willamina	Met	Met	Met	Did not meet	Did not meet	Did not meet	Slight impairment	

5 Sites are organized upstream to downstream within each subwatershed.
6 $=10^{((LOG_{10}(A)+LOG_{10}(B)+LOG_{10}(C)+LOG_{10}(D)+LOG_{10}(E))/5)}$, where A-E are the number of cells/100mL in five samples collected over 30 days.
7 Most Probable Number (MPN) of cells using a Quanti-Tray Enumeration Test Procedure.
8 A multi-metric value determined by taxa richness, mayfly richness, stonefly richness, caddisfly richness, sensitive taxa, sediment sensitive taxa, modified HBI (indicator of organic enrichment), % tolerant taxa, % sediment tolerant and % dominant taxa.
9 <20 = severe impairment, 20-30 = moderate impairment, 30-40 = slight impairment, >40 = no impairment.

Chapter 2 – Introduction and Background

The Yamhill Basin Council (YBC) was founded in 1995 and consists of 27 members. The Yamhill River watershed (769 square miles) and the Chehalem Creek watershed (56 square miles) span Yamhill and Polk counties. The Yamhill River and creeks of the Chehalem watershed flow into the Willamette River. Elevation in the Yamhill Basin ranges from 60 to 3,600 feet. The amount of annual rainfall ranges widely, from 40 inches at the valley bottom to 150 inches at the highest elevations in the basin.

Though the predominant land uses in the Yamhill Basin are forestry and agriculture, urban areas are growing rapidly. The current population of the Yamhill River and Chehalem Creek watersheds is approximately 93,128 (YBC Support Grant, 2003)). Approximately 186,000 acres of Yamhill County are farmlands, down from 284,000 in 1900. There are approximately 1,800 farms in the county, with an average size of 103 acres (QAPP 2002). The forested areas are generally in the western part of the watershed, in the foothills and upper elevations of the Coast Range.

Stream flow in the Yamhill Basin varies throughout the year, and the high and low flows have different impacts on the landscape and resources. Stream flows vary widely between summer and winter largely due to the amount of rainfall. Water diverted for irrigation during the summer also contributes to the fluctuations in flow. The South Fork of the Yamhill River, for example, has an average flow of 30 cfs during the summer low flow condition and 6,000 cfs during the winter high flow condition (QAPP 2002). A prominent resource concern is soil erosion. Also, leached nutrients and pesticides that negatively affect water quality and serve as an economic loss for producers. During periods of low stream flow, nutrients, heat load, and pesticides can more easily impact water quality because lower stream flows provide less dilution of contaminants. Additionally, the higher stream temperatures associated with low flow in the summertime are a major factor affecting aquatic life.

The diversity and acreage of natural wildlife habitat in the basin have been reduced as land has been converted from natural forest and grasslands to managed forests, pasture, cropland, homesteads, and urban areas. Studies estimate that around 40% of the original wetlands in the Willamette Valley have been lost (QAPP 2002). As a result, some of the ecological functions of wetlands and riparian areas have been impaired. These areas filter contaminants, trap sediment, and provide wildlife habitat. Wetland and riparian vegetation also minimizes hydrologic fluctuations by retaining water during high flows. This water may then replenish groundwater or provide shallow subsurface flow to streams. Both of these flow mechanisms are important for water quality, since groundwater provides most of the instream water during summertime periods of low precipitation.

Surface water quality in the Yamhill Basin can vary seasonally. During the summer low flow periods, sections of the middle and lower reaches have poor water quality for several parameters. Some seasonal variation in water quality in the Yamhill Basin probably occurred prior to European settlement due to the natural characteristics of the stream. Diversions of water and hydrologic changes (created by activities such as tiling or impoundments) have exaggerated seasonal variations. These reductions in flow and some loss of shading by riparian vegetation have both probably contributed to some increases in water temperature. Also, point (from a well-defined, relatively concentrated source) and nonpoint (from a wide range of activities in both rural and urban areas) source discharges have adversely affected water quality.

There are several sources of water pollution in the Yamhill Basin. Non-point sources of pollution in the Yamhill Basin include erosion from agricultural, rural, forest lands and streambanks, chemicals from roadsides and urban areas, contaminated runoff from livestock and other agricultural operations, and contaminated runoff from established urban areas, septic systems, and natural sources. Pollutants from non-point sources are carried to the surface water or groundwater through the action of rainfall, irrigation runoff, and seepage. Point sources of pollution include treated wastewater and occasional sewer overflows from municipalities. While this project measured turbidity and *E. coli* levels during summer low flow conditions, nutrient and pesticide levels were not monitored.

Several of the Yamhill Basin's fish and aquatic vertebrate populations are currently in decline. The Upper Willamette steelhead is listed under the Endangered Species Act. Pacific lamprey (another anadromous, cold water species) is currently listed as vulnerable on the Oregon Sensitive Species List and is of special concern to tribal communities due to its cultural importance. The Columbia seep salamander and the Western pond turtle are currently listed as critical on the state Sensitive Species List, while the status of the tailed frog and red-legged frog is vulnerable.

Table 2.1 Examples of Aquatic Vertebrates Found in the Yamhill Basin (QAPP 2002).

Yamhill Basin Aquatic Vertebrates
Red-sided shiner
Northern pike minnow
Largescale and bridgeslip sucker
Pacific lamprey
Brook lamprey
Sculpin species
Winter steelhead
Cutthroat trout
Spring Chinook salmon (juvenile)
Western pond turtle
Pacific giant salamander
Tailed frog
Red-legged frog
Columbia seep salamander

Water quality is a significant natural resource issue in the Yamhill River and Chehalem Creek watersheds. It affects fish and wildlife while also being an important natural resource to watershed residents who use surface water for municipla water supply, irrigation, livestock watering, water contact recreation, fishing and boating in various water bodies throughout the area. Through sampling efforts conducted by ODEQ, some problem areas in the basin have been identified[10], but there are other areas where little or no data exists. Previously, very little monitoring took place on the lowlands of Yamhill County. The majority of monitoring taking place in the basin occurs on tribal land (Confederated Tribes of Grand Ronde), BLM, or private forest industry lands on the edges of the basin.

In 1998, the YBC began continuous temperature monitoring in streams throughout the area and has been the only organization focused on widespread monitoring in the lower portions of the basin, at agricultural, rural residential, and city sites. While this data is important, more information on stream conditions would help with understanding and working to improve the health of the watersheds. In addition, collecting more data would help the ODEQ develop Total Maximum Daily Loads (TMDL) for 303(d) listed waters by the target completion date of 2007 (ODEQ website). Creating TMDLs involves gathering information on a basin scale to calculate the level of pollution reduction needed for streams to meet state water quality standards.

The Yamhill Sub-Basin Agriculture Water Quality Management Area Plan (also known as SB 1010 after the Senate Bill that created it) impacts all landowners living outside urban growth boundaries and not covered by the Forest Practices Act. The plan's overall mission is to identify voluntary strategies that landowners may use to reduce water pollution in the Yamhill River sub-basin. The Ag Water Quality Management Plan (AgWQMAP) was developed locally through the efforts of a Local Advisory Committee (LAC) consisting of affected landowners residing within the basin, the Yamhill Soil and Water Conservation District and the Oregon Department of Agriculture. The plan relies on the voluntary efforts of landowners as they work toward Best Management Practices, which are common-sense activities that farmers may utilize to reduce pollution and help make their farms more efficient. The areas targeted by the LAC include: erosion prevention and sediment control; irrigation management; livestock waste; nutrient management; pesticide management; chemigation; streamside areas; and, roads and farmsteads (QAPP 2002). Continued voluntary water quality monitoring would help identify areas that may benefit from prevention and control methods. It is expected that it would also promote public awareness and acceptance of the Yamhill AgWQMAP. Increased knowledge on water quality in the basin would also help direct the Soil and Water Conservation District's efforts to improve water quality.

To expand its monitoring program, the YBC successfully applied for a grant from the Oregon Watershed Enhancement Board (OWEB) to conduct a Water Quality Monitoring Project (WQMP) in 2003 and 2004. This project was also supported by matching funds and in-kind donations from the YBC, Yamhill Soil and Water Conservation District (SWCD), Oregon Department of Agriculture (ODA), McMinnville Water Reclamation Facility (WRF), Oregon Department of Environmental Quality (ODEQ), Natural Resource Conservation Service (NRCS) and landowners. The following chapters describe the development and implementation of this project, as well as the results.

[10] See Table 2.2 ODEQ Water Quality Limited Streams in the Yamhill Basin.

Chapter 3 Monitoring Project

Key Components:

1. Baseline water quality monitoring of temperature, dissolved oxygen, pH, turbidity, conductivity and *E. coli* in 2003 and 2004 to support Agricultural Water Quality Management Area Plan (SB 1010) in the Yamhill Basin
2. Collection of benthic macroinvertebrates in 2003 and 2004 to determine where benthic macroinvertebrate communities are intact regardless of water quality

WQMP Goals:

- Assess water quality in areas of the basin that currently receives little or no monitoring
- Refine our understanding of water quality in each sub-basin
- Prioritize areas/sub-basins in need of water quality improvement
- Prioritize types of best management practices on private lands
- Identify additional water quality studies if necessary
- Provide opportunities to educate and involve landowners, residents, and high-school age youth in water quality monitoring and analysis
- Share water quality information with stakeholders and decision-makers
- Evaluate water quality issues identified on 303(d) list
- Combine macroinvertebrate data with other water quality data to provide supporting rationale for impairment of biologic criteria
- Collect data to be provided to ODEQ or other agencies in the eventual creation of new reference sites in the area that better reflect lowland conditions

Twenty-five sites were chosen for the WQMP with the following objectives in mind:

- Characterize water quality in 303(d) listed streams (see Table 3.1)
- Aid the YBC in selection of potential restoration sites and projects
- Investigate spatial variation of water quality along streams (upstream-downstream)

2003 Monitoring Sites in the Yamhill and Chehalem Watersheds

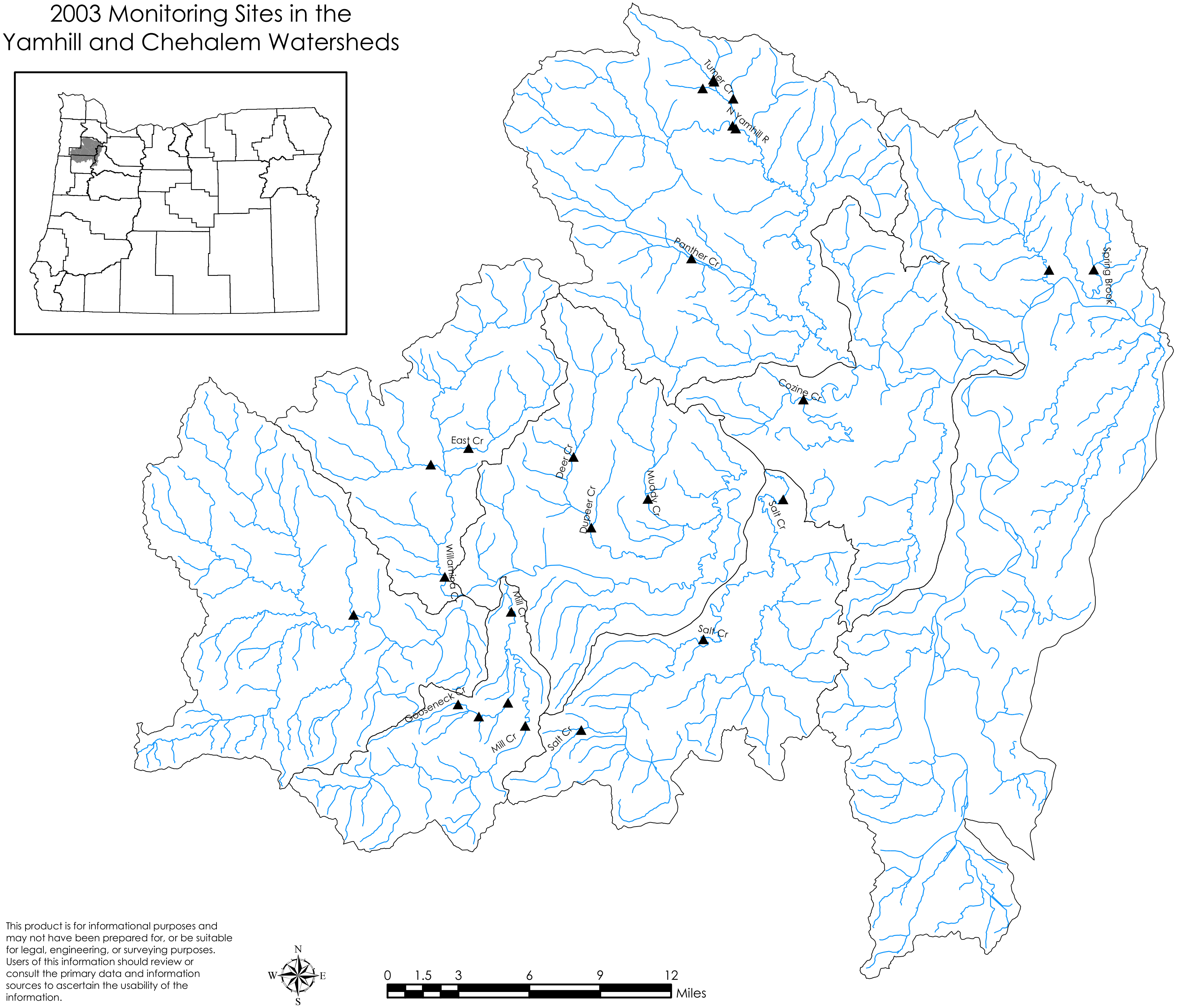

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Table 3.1 ODEQ Water Quality Limited Streams in the Yamhill Basin.[11]

Waterbody Name	River Mile	Parameter	Season	List Date	YBC Site[12]
Baker Creek	0 to 14.2	Temperature	Summer	2002	Yes
Cedar Creek	0 to 2.3	Iron	Year Around	2002	No
Deer Creek	0 to 12	Temperature	Summer	1998	Yes
Deer Creek	0 to 20.4	Fecal Coliform	Year Around	1998	Yes
Deer Creek	0 to 20.4	Fecal Coliform	Summer	1998	Yes
Mill Creek	0 to 22.2	Fecal Coliform	Summer	1998	Yes
Mill Creek	0 to 17	Temperature	Summer	2002	Yes
North Yamhill River	0 to 20.1	Temperature	Summer	1998	Yes
North Yamhill River	0 to 20.1	Fecal Coliform	Winter/Spring/Fall	1998	Yes
North Yamhill River	0 to 20.1	Fecal Coliform	Summer	1998	Yes
North Yamhill River	20.1 to 32.4	Temperature	Summer	1998	Yes
North Yamhill River	0 to 20.1	Dissolved Oxygen	October 1 - May 31	2002	Yes
Panther Creek	0 to 14	Temperature	Summer	2002	Yes
Salt Creek	0 to 32.8	Manganese	Year Around	2002	Yes
Salt Creek	0 to 32.8	Temperature	Summer	1998	Yes
Salt Creek	0 to 32.8	Fecal Coliform	Winter/Spring/Fall	1998	Yes
Salt Creek	0 to 32.8	Dissolved Oxygen	Spring/Summer/Fall	1998	Yes
Salt Creek	0 to 32.8	Chlorophyll a	Summer	1998	Yes
South Yamhill River	0 to 18.1	Iron	Year Around	2002	No
South Yamhill River	18.1 to 42.6	Fecal Coliform	Summer	1998	No
South Yamhill River	0 to 18.1	Temperature	Summer	1998	No
South Yamhill River	18.1 to 42.6	Temperature	Summer	1998	No
South Yamhill River	0 to 18.1	Fecal Coliform	Winter/Spring/Fall	1998	No
South Yamhill River	18.1 to 42.6	Fecal Coliform	Winter/Spring/Fall	1998	No
South Yamhill River	42.6 to 61.7	Fecal Coliform	Summer	1998	No
Turner Creek	0 to 2.5	Temperature	Summer	1998	Yes
West Fork Palmer Creek	0 to 5.2	Chlorpyrifos	Year Around	1998	Yes
Willamina Creek	0 to 9.9	Fecal Coliform	Winter/Spring/Fall	1998	Yes
Yamhill River	0 to 11.2	Temperature	Summer	1998	No
Yamhill River	0 to 11.2	Fecal Coliform	Winter/Spring/Fall	1998	No
Yamhill River	0 to 11.2	Iron	Year Around	2002	No
Yamhill River	0 to 11.2	Manganese	Year Around	2002	No

[11] Tributaries to listed streams are also considered listed (pers. comm. Steve Hanson, ODEQ 2003).
[12] YBC monitored one or more parameters in 2003 or 2004 at a site along this waterbody. See site map on page 12, which includes all but the Palmer Creek site.

Water Quality Parameters Monitored

Water Temperature

Water temperature directly affects the metabolism of aquatic organisms and thus their growth and ability to survive. High temperatures may be fatal to fish and other organisms. Therefore, the ODEQ has set a **maximum standard of a 7-day average high of 64.4ºF.** This guideline was created with salmonids in mind, but tolerable temperatures are different for each aquatic species and life cycle stage.

Dissolved Oxygen

Low DO levels can be fatal to fish and other organisms. Therefore the ODEQ has set a **minimum standard of 8 mg O_2/L** for cold water rearing and 11 mg O_2/L for salmon spawning[13]. Streams are placed on the ODEQ 303(d) list if $\geq$ 10% of samples have less than 8 mg O_2/L. Many aquatic species use dissolved oxygen for metabolizing chemical energy. Dissolved oxygen refers to the amount of oxygen that is dissolved in a liquid due to atmospheric pressure and temperature. Cool water contains more DO while warmer water contains less DO. Plant photosynthesis and aeration (such as in riffles and falls) increase DO, while animal respiration and aerobic decomposition of organic materials (Biological Oxygen Demand) decrease DO.

Turbidity

There is no relevant ambient background standard, but **less than 3 nephlometric turbidity units (NTU) is a low flow background guideline** for preventing salmonid impaction (pers. comm., Tom Rosetta ODEQ 2003). The ODEQ standard is that activities may not increase turbidity more than 10% above background turbidity levels. Turbidity is the property, or ability, of a sample to absorb or scatter light. Turbidity is measured in NTU and is related to total suspended solids, which measures the amount of solids remaining when a sample is heated to evaporate all liquids. Turbidity is an indicator of the presence of suspended fine sediment and aquatic organisms such as algae. Suspended fine sediments are harmful because they may impact salmonid physiology, behavior and habitat (Bash, 2001).

pH

The ODEQ **standard for pH is 6.5-8.5** in the Yamhill River and Chehalem Creek watersheds. pH measures how acidic (excess H^+) or basic (excess OH^-) a liquid is, based on the equation $pH = -log_{1-}[H^+]$. pH values below 7 are acidic, values of 7 are neutral and values above 7 are basic. Rainwater in the area ranges between pH 5-6. The pH of surface water is also dependent on geology, human activities and plants. During the day, photosynthesis increases pH, and during the night pH levels decrease (Thieman, 2001). The pH is critical because it may "affect fish egg production and survival, aquatic insect survival and emergence and the toxicity of other pollutants such as heavy metals or ammonia" (Water Quality, 1999).

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13 See Appendix A ODEQ criteria for DO and intergravel DO.

Conductivity

While the ODEQ has not set a standard range or maximum, conductivity in the Willamette Valley is **expected to be 180 mhos/cm or less**. Conductivity, or specific conductance, measures the ability of a sample to conduct electricity. Temperature and concentration of ions influence the conductivity of a sample. Conductivity is influenced by geology and stream flow. High conductivities may indicate human-related activities such as wastewater and urban runoff.

Escherichia coli

The state standard for *E. coli* calls for **no more than 406 MPN/100 mL in any sample or a geomean of five samples taken over 30 days no more than 126 MPN/100mL**[14]. *E. coli* is a species of bacteria that may be used as an indicator of fecal contamination since it is found in animal wastes and is easily quantified in the lab. Presence of *E. coli* in stream samples means that other pathogens may be present. Consistent values may be the result of humans, wildlife, domesticated animals, livestock or malfunctioning septic systems. Precipitation also influences values, increasing values if animal wastes wash in or decreasing values by dilution (pers. comm., Steve Hanson ODEQ 2003).

Benthic Macroinvertebrates

After a sample of benthic macroinvertebrates is identified, ten metrics, or subsets of data, are scored and summed to arrive at a Benthic Index of Biotic Integrity[15] (B-IBI) value between 10 and 50, which is then scored to determine impairment as compared to reference sites. A site with a **B-IBI value of 40 or above suggests no impairment**[16] of the benthic macroinvertebrate community. Benthic macroinvertebrates provide another way of assessing water quality beyond chemical parameters.

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[14] The equation is $=10\text{^}(\log_{10}V+ \log_{10w}W+ \log_{10}X+ \log_{10}Y+ \log_{10}Z)$.

[15] See Appendix B for further explanation of benthic macroinvertebrate sample processing and metrics.

[16] Or equivalent to a reference site where little or no disturbance has occurred.

Chapter 4 –Methodology

The Monitoring Technician and volunteers collected samples and measurements according to standard protocols in the OWEB *Water Quality Monitoring Guidebook*. ODEQ Volunteer Monitoring Coordinator Steve Hanson and ODEQ Aquatic Biologist Aaron Borisenko provided hands-on training in May 2003. Attendees practiced measuring temperature, turbidity, dissolved oxygen, conductivity and practiced collecting water samples for *E. coli* analysis and benthic macroinvertebrate samples. Throughout the summer of 2003 the Monitoring Technician trained additional volunteers.

The WQMP consisted of measuring several chemical, biological and physical parameters, as summarized in Table 4.1.

Table 4.1 Sampling Frequency and Instruments for Monitoring.

Number of Sites in 2003	Number of Sites in 2004	Parameter	Sampling Frequency	Method
25	24	Temperature	Once a month, June-October; continuous	VWR NIST Traceable Thermometer; VEMCO data loggers
25	15	Dissolved oxygen	Once a month, June-October	Winkler titration with Hach OX-DT (digital titrator and powdered reagents)
25	15	Turbidity	Once a month, June-October	Hach 2100P Turbidimeter
25	15	pH	Once a month, June-October	Oakton pH Tester (2003) Orion 210A pH Meter with Ross electrode and ATC probe (2004)
25	15	Conductivity	Once a month, June-October	YSI Model 30 Conductivity Meter
18	16	*E. coli*	5 in 30 days in August-September	Quanti-Tray 2000 MPN Enumeration Test Procedure with Colilert reagents, analyzed at WRF
13	4	Benthic macroinvertebrates	Once in September	8 ft^2 composite sample of 8 kicks with a 500 micron net, identified by contractor
13	4	Substrate	Once in September	Modified Wollman pebble count
13	4	Wetted width	Once in September	Tape measure
13	4	Gradient	Once in September	Clinometer
13	4	Canopy cover	Once in September	Densiometer

Water Temperature - Continuous

Continuous temperature monitoring was measured and recorded with VEMCO temperature loggers that were audited for accuracy by comparing their measurements against a factory-calibrated NIST traceable thermometer[17] before and after deployment. The loggers were factory-calibrated (QAPP, 2003). In 2003, loggers were deployed at the end of June and retrieved at the end of October. In 2004, loggers were deployed at the beginning of May and retrieved at the end of September or at the beginning of October. The earlier deployment in 2004 was an attempt to collect data which would characterize the late spring rise in stream temperatures. The earlier retrieval in 2004 was based on rain events and a concern over losing equipment. The loggers were set to record stream temperatures every 30 minutes. Loggers were audited in the field at deployment, mid-season and at retrieval with the same NIST traceable thermometer. Loggers were staked in the streambed or tied to branches so that they were suspended in the deepest part of the flow as possible, due to low summer flows at many of the sites. Initialization of the loggers was performed using the VEMCO minilog program. Analysis of the data was completed using the ODEQ's Hydrostat Simple program.

Water and Air Temperatures - Point

Point water and air temperatures were measured once a month with the NIST thermometer or YSI conductivity meter. The thermometer was calibrated/checked by the ODEQ. The conductivity meter was factory-calibrated. The thermometer probe was suspended in the air or water, allowed to equilibrate and recorded immediately. A potential source of error was not allowing the thermometer to equilibrate completely.

Dissolved Oxygen

Dissolved oxygen was measured using the Winkler titration method and Hach standard pre-measured crystal reagents and liquid titrant. Every month, one sample was collected at each of the 25 sites and at least one additional sample each field day was randomly collected for QA of precision. A 300mL labeled glass BOD bottle was slowly filled to overflowing in the stream. One powder pillow of manganous sulfate and one powder pillow of alkaline azide were added simultaneously. While keeping out air bubbles, the bottle was stoppered and inverted vigorously for about 20 seconds. After the precipitate had settled halfway, the bottle was inverted vigorously for about another 20 seconds. After settling a second time, one powder pillow of sulfamic acid was added, the bottle stoppered and inverted again. The fixed sample was transported in a cooler with ice for no more than 8 hours (often fewer) to the WRF. At the WRF, 200mL of the amber-colored sample was titrated in a flask. A Hach digital titrator was used to deliver 0.02 N or 0.2 N sodium thiosulfate titrant until the sample was light yellow, then a dropper full of starch indicator solution was added to turn the solution blue and titration continued to the endpoint when the solution was clear. The amount of dissolved oxygen in the sample was immediately recorded in mg O_2/L. Not vigorously shaking the sample was a possible source of error. This method using Hach products has consistently resulted in 2-4% lower DO levels than a standard wet chemical method, possibly due to the titrator or titrant (pers. comm., Steve Hanson ODEQ 2003).

[17] In 2003, unit #51929. In 2004, unit #51929 was used initially and #51907 was used for the latter half of the season. Both audited with a NIST certified thermometer on 3/5/03 by Steve Hanson, ODEQ from 5ºC-25ºC.

Turbidity

Turbidity was measured once a month with a Hach 2100 turbidimeter. The turbidimeter was calibrated with a StablCal calibration set (see APPENDIX E) every three months. Additionally, the turbidimeter was checked against formazin secondary standards every morning and evening of each field day. Immediately after collecting the sample, a clean sample cell was filled with stream water, wiped clean and placed in the turbidimeter and read. Three separate samples were measured, recorded immediately and the average used throughout this report. Potential sources of error were not filling the sample cell to the line, not wiping off the sides of the sample cell and using a scratched or dirty sample cell.

pH

In 2003, pH was measured once a month[18] with an Oakton waterproof double junction pH tester 2. The pH probe was calibrated the morning of every field day with pH 7 and 10 buffers and checked against those buffers every evening for drift. In 2004, pH was measured once a month with an Orion pH tester and Ross electrode. The pH probe's calibration was checked the morning of every field day with pH 7 and 10 buffers as well as every evening for drift. If the readings were greater than 0.05 pH units different than the theoretical readings, the pH meter was recalibrated in pH 7 and 10 buffers. Immediately after collecting the sample, the probe was placed in a cup containing approximately 150 mL of stream water and allowed to stabilize. If the conductivity was less than 100 s/cm, then 1 mL of pHisa ionic strength adjustor was added to 100 mL of stream water. The pH reading was recorded immediately. A potential source of error was not allowing the pH probe to equilibrate completely.

Conductivity

Conductivity was measured once a month with a YSI conductivity and temperature meter. The conductivity meter was factory calibrated and tested at the beginning of the 2003 monitoring season with 1000 mhos/cm standard solution. The meter probe was suspended in the stream and the specific conductance was recorded immediately. Potential sources of error included fluctuating conductivity values and having air bubbles on the probe.

Escherichia coli

To test for *E. coli*, stream samples were collected in labeled autoclaved bottles opened upstream and underwater and transported in a cooler with ice to the WRF in 5.5 hours or less. A chain of custody sheet was completed every day and surrendered to the laboratory technicians at the WRF at the end of each day. Every Tuesday and Wednesday for five weeks, samples were collected at 18 sites in 2003 and 16 sites in 2004. Duplicate samples were collected at four[19] randomly chosen sites for QA of precision. At the WRF, the Quanti-Tray 2000 MPN Enumeration Test Procedure and Colilert reagents were used. 100 mL of stream water were distributed into the wells of a tray using a Quanti-Tray Sealer and

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[18] pH was not measured in June or October due to equipment failure.

[19] In 2003, week 2 and 3 only - three duplicates were collected and a fourth was accidentally forgotten. Week 4 two duplicates were collected and both Deer Creek sites were accidentally not sampled. In 2004, one sample during week 2 and week 3 was unreadable. Week 3 one sample was not collected because the site was unaccessible.

incubated at 35 degrees Celsius for approximately 24 hours. The trays were read under normal light to count the number of wells where the reagents turned yellow, corresponding to the Most Probable Number (MPN) of total coliforms (includes bacteria naturally occurring in the environment) per 100 mL and read under UV light to count the number of fluorescing wells, corresponding to the MPN of *E. coli* [20].

Benthic Macroinvertebrates

Benthic macroinvertebrates were collected using ODEQ protocols. A D-frame kick net with 500 micron netting was used to catch macroinvertebrates in eight separate 1ft^2 squares in 4-8 riffles at each site. Moving downstream to upstream, rocks were scrubbed and substrate was disturbed for several centimeters with the hands and feet. Duplicate samples were collected at two of the sites in different 1ft^2 squares. Samples were preserved in 91% isopropanol in labeled plastic containers. Most of the alcohol was removed and replaced with new alcohol within 24-48 hours.

Physical Habitat

Several physical parameters were measured immediately following benthic macroinvertebrate sampling. Transects were a minimum of 25 feet and a maximum of 50 feet apart, based on an average of three random wetted widths measured at the downstream end of the reach. A modified Wollman pebble count to sample substrate type was conducted, with five samples (left bank, ¼ width, center, ¾ width, right bank) along each of 21 transects for a total of 105 samples. Wetted width was measured along 21 transects. Gradient was measured between transect 1 and 3, 3 and 5, etc. or more/less depending on visibility. Canopy cover was measured on the 1st, 6th, 11th, 16th and 21st transects at the left bank, center upstream, center left, center downstream, center right and right bank.

Location

Latitude and longitude were collected with an eTrex Summit personal navigator and recorded to the nearest tenth of a second. In order to protect the privacy of the landowners, specific locations will not appear in this report.

Data Quality

Data was graded according to ODEQ standards (see Table 3.2 for requirements for obtaining the A quality data). Steve Hanson of ODEQ accompanied the Monitoring Technician in August of 2003 to conduct split samples. For data quality levels, calibration records, duplicate sample results and split sample report, see APPENDIX E.

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[20] The maximum measurable amount is 2419 MPN/100mL.

Chapter 5 – Results

Samples were collected and measured throughout the morning and early afternoon. Field days were grouped together. For monthly monitoring, samples were collected at approximately the same time of day each month. Please take this into consideration when comparing data between sites or between months or years, especially for point temperature, pH and dissolved oxygen data. Refer to APPENDIX G for collection times.

Notes

No pH data was collected in June or October 2003 because of equipment problems.

Eighteen sites in 2003 and 16 sites in 2004 were sampled for *E. coli*, due to the cost of the media and availability of staff time to collect and process samples. Sites were chosen based on sufficient stream flow, safety and representation of the area. Results may have been affected by rainfall in the basin during the 3rd week of sampling in 2003 and 2nd and 5th weeks of sampling in 2004.

There is no specific ODEQ standard for benthic macroinvertebrates[21]. Thirteen sites in 2003 and four sites in 2004 were sampled for benthic macroinvertebrates, due to the cost of identification and analysis as well as availability of staff time to collect and process samples. Sites were chosen based on sufficient stream flow, safety, presence of riffles and representation of the area.

Table 5.1 summarizes the importance of the monitored parameters and 2003 and 2004 monitoring results. Tables 5.2 and 5.3 summarize monitoring results in 2003 and 2004 at sites throughout the basin. The sites are organized upstream to downstream within subwatersheds, which are organized alphabetically. The tables show whether data collected at each site met or did not meet standards or guidelines for that parameter. Empty cells indicate that data was not collected at that site.

[21] From the Oregon Administrative Rules, 340-041-0011 states that "Waters of the State must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities."

Table 5.1 Water Quality Parameters and 2003-2004 Results.

Parameter	Importance	2003 Results[22]	2004 Results
Temperature	Affects metabolism, growth and survival of aquatic organisms	2 sites met the standard 22 sites exceeded the standard	1 site met the standard 23 sites exceeded the standard
Dissolved Oxygen	Necessary for salmonid survival High levels needed for fish eggs	13 sites met the standard 12 sites did not meet the standard	7 sites met the standard 8 sites did not meet the standard
Turbidity	High levels may clog gills and impair foraging of salmonids	10 sites met the guideline 15 sites exceeded the guideline	4 sites met the guideline 11 sites exceeded the guideline
pH	Extremes may affect fish egg and aquatic insect survival Extremes may affect toxicity of pollutants such as ammonia and heavy metals	25 sites met the standard	15 sites met the standard
Conductivity	High levels may indicate water pollution	15 sites met the guideline 10 sites exceeded the guideline	10 sites met the guideline 5 sites exceeded the guideline
E. coli	High levels indicate a health risk to humans High levels indicate nutrient loading to streams	6 sites met both standards 12 sites did not meet one or both standards	2 sites met both standards 14 sites did not meet one or both standards
Benthic Macroinvertebrates	Presence or absence of different species suggests level of stream impairment or disturbance	10 sites indicate slight impairment 3 sites indicate moderate impairment	3 sites indicate slight impairment 1 site indicates moderate impairment

[22] The original monitoring plan was to collect data on all parameters at 25 sites in 2003 and 14 sites in 2004. Due to budget limitations, *E. coli* and benthic macroinvertebrate samples were collected at fewer sites. For *E. coli* and benthic macroinvertebrate sampling, site selection was based on safety, site comparability, and stream flow. For 2004 monitoring, site selection was based on safety, stream flow and ability to represent each subwatershed.

Table 5.2 Summary of 2003-2004 Temperature, Dissolved Oxygen, Turbidity and pH Results.

Subwatershed	Site[23]	2003 Temperature	2004 Temperature	2003 Dissolved	2004 Dissolved	2003 Turbidity	2004 Turbidity	2003 pH	2004 pH
		7-day avg	7-day avg	Oxygen	Oxygen				
STANDARD or	**GUIDELINE →**	**< 64.4F[24]**	**< 64.4F**	**> 8 mg/L[25]**	**> 8 mg/L**	**< 3 NTU**	**< 3 NTU**	**6.5-8.5**	**6.5-8.5**
Chehalem	Chehalem	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Met	Met
Chehalem	Spring Brook	Did not meet	Data lost	Did not meet	Did not meet	Did not meet	Did not meet	Met	Met
Lower South Yamhill	Upper Deer	Did not meet	Did not meet	Met	Met	Did not meet	Did not meet	Met	Met
Lower South Yamhill	Lower Deer	Did not meet	Did not meet	Did not meet		Did not meet		Met	
Lower South Yamhill	Muddy	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Met	Met
Lower Yamhill	Cozine	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Met	Met
Mill	Upper Gooseneck	Met	Met	Did not meet		Did not meet		Met	
Mill	Middle Gooseneck	Did not meet	Did not meet	Did not meet	Did not meet	Met	Met	Met	Met
Mill	Lower Gooseneck	Did not meet	Did not meet	Did not meet		Met		Met	
Mill	Upper Mill	Did not meet	Did not meet	Met	Met	Met	Met	Met	Met
Mill	Lower Mill	Did not meet	Data lost	Met	Met	Met	Met	Met	Met
North Yamhill	Hay	Did not meet	Did not meet	Did not meet		Did not meet		Met	
North Yamhill	Wildwood	Met	Did not meet	Met	Met	Did not meet	Did not meet	Met	Met
North Yamhill	Hawn (went dry)	Did not meet	Did not meet	Did not meet		Did not meet		Met	
North Yamhill	Middle Turner	Did not meet	Did not meet	Met		Met		Met	
North Yamhill	Lower Turner	Did not meet	Did not meet	Met	Did not meet	Did not meet	Did not meet	Met	Met
North Yamhill	North Yamhill	Did not meet	Did not meet	Met	Met	Met	Met	Met	Met
North Yamhill	Panther	Did not meet	Did not meet	Met	Did not meet	Did not meet	Did not meet	Met	Met
North Yamhill	Baker								
Salt	Upper Salt	Did not meet	Did not meet	Met		Met		Met	
Salt	Middle Salt	Data Lost		Did not meet		Did not meet		Met	
Salt	Lower Salt	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Met	Met
Upper South Yamhill	Cosper	Did not meet	Did not meet	Met	Met	Did not meet	Did not meet	Met	Met
Willamina	East	Did not meet	Did not meet	Met		Met		Met	
Willamina	Coast	Did not meet	Did not meet	Met		Met		Met	
Willamina	Willamina	Did not meet	Did not meet	Met	Met	Met	Did not meet	Met	Met

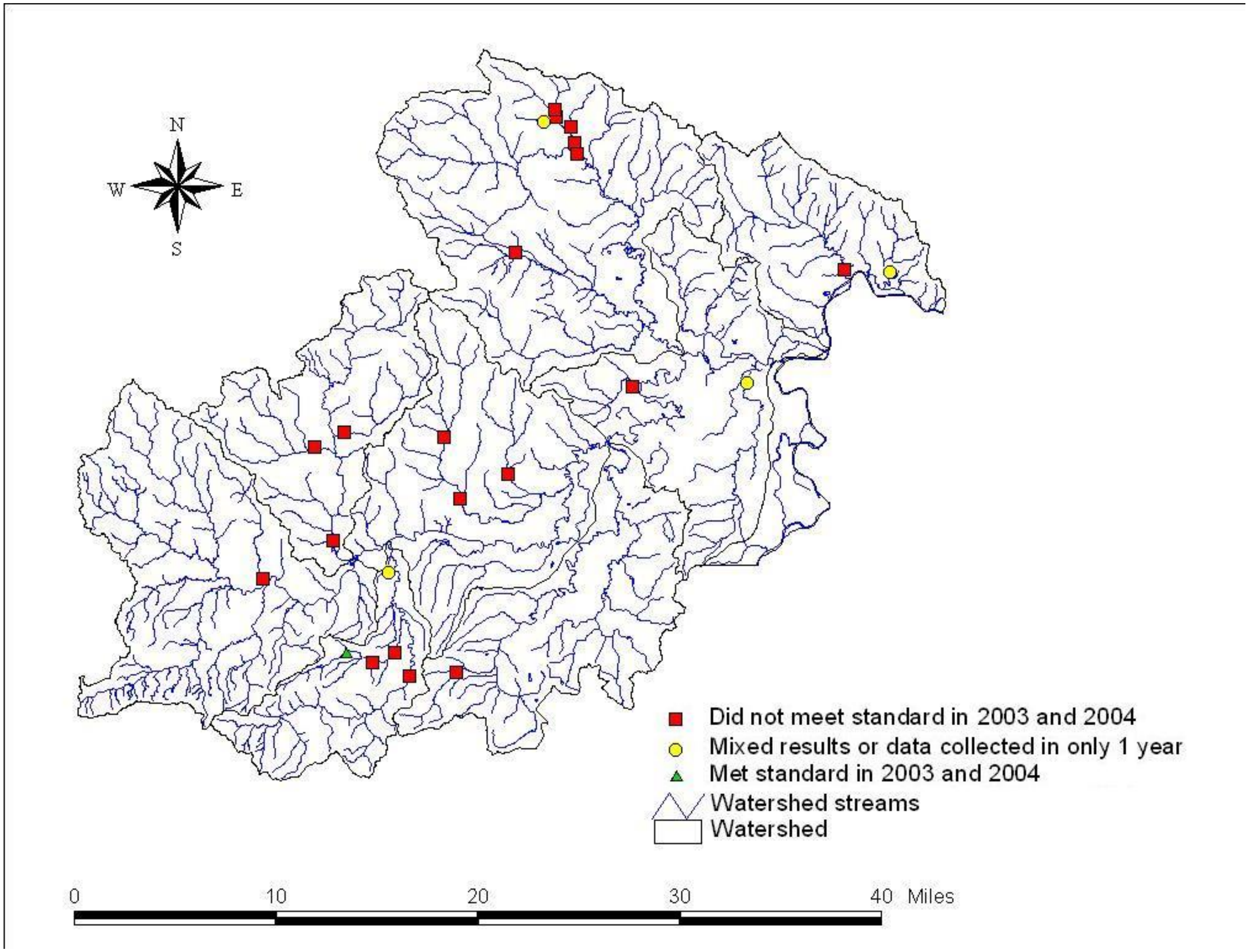
[23] Sites are organized upstream to downstream within each subwatershed.
[24] ODEQ standard for 303(d) listing is a 7 day average high over 64.4ºF. However, data was analyzed with a program that used 64ºF as the standard.
[25] ODEQ standard for 303(d) listing is >10% samples measuring <8 mgO_2/L.

Table 5.3 Summary of 2003-2004 Conductivity, *E. coli* and Benthic Macroinvertebrate Results.

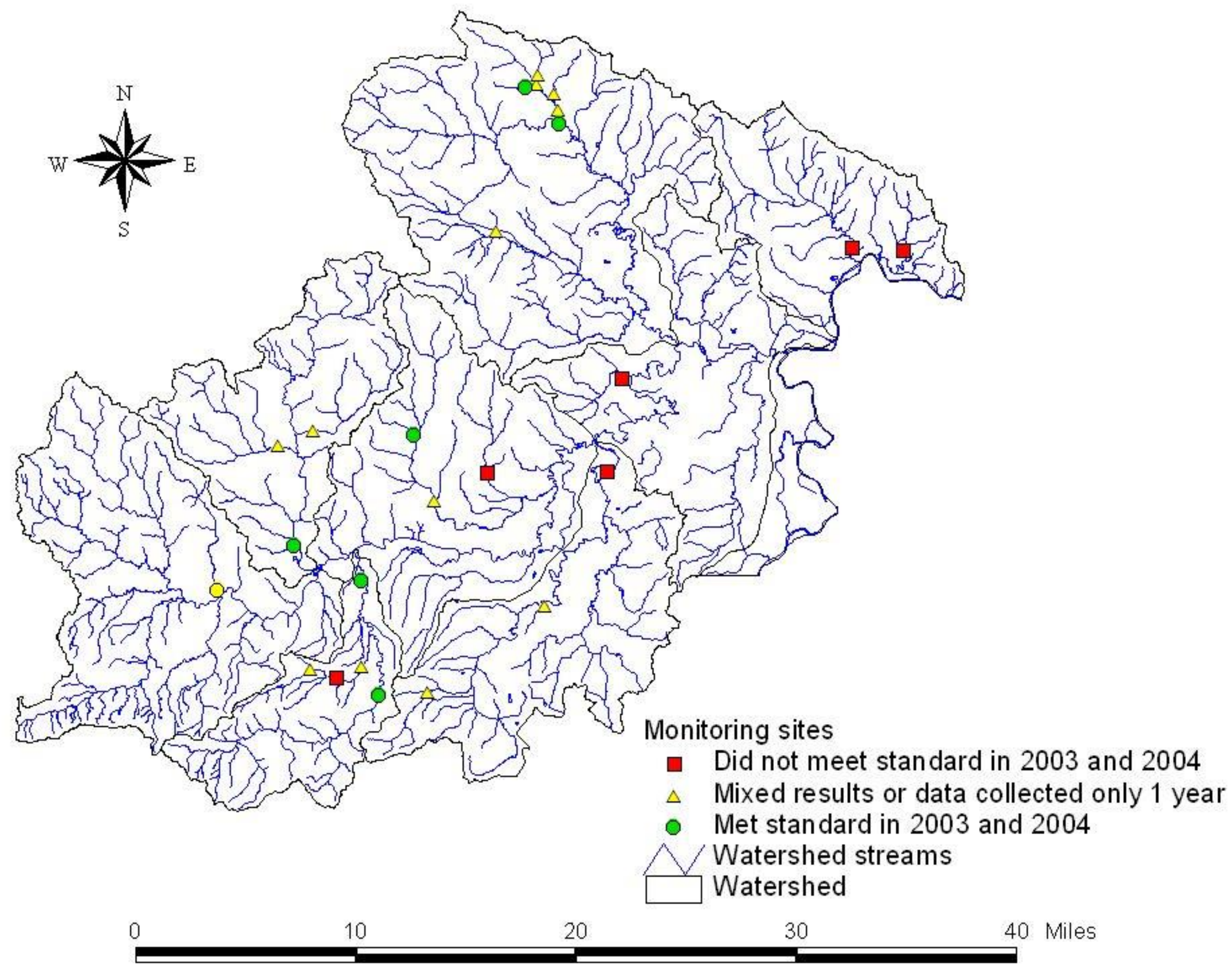
Subwatershed	Site[26]	2003 Conductivity	2004 Conductivity	2003 *E. coli* All samples	2004 *E. coli* All samples	2003 *E. coli* Geomean[27]	2004 *E. coli* Geomean	2003 Benthic Macroinvertebrates	2004 Benthic Macroinvertebrates
STANDARD or	GUIDELINE →	< 180 mhos/cm	< 180 mhos/cm	< 406cells[28]/100mL	< 406cells/100mL	< 126cells/100mL	< 126cells/100mL	B-IBI[29] values 10-50[30]	B-IBI values 10-50
Chehalem	Chehalem	Did not meet	Did not meet	Did not meet	Met	Did not meet	Met		
Chehalem	Spring Brook	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet		
Lower South Yamhill	Upper Deer	Met	Met	Did not meet				Slight impairment	
Lower South Yamhill	Lower Deer	Met		Did not meet	Did not meet		Did not meet		
Lower South Yamhill	Muddy	Did not meet	Did not meet		Did not meet		Did not meet		
Lower Yamhill	Cozine	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet	Did not meet		
Mill	Upper Gooseneck	Met							
Mill	Middle Gooseneck	Met	Met	Met	Met	Met		Moderate impairment	Slight impairment
Mill	Lower Gooseneck	Did not meet		Did not meet		Met			
Mill	Upper Mill	Met	Met	Met		Met		Slight impairment	
Mill	Lower Mill	Met	Met	Met	Did not meet	Met		Moderate impairment	Slight impairment
North Yamhill	Hay	Did not meet						Slight impairment	
North Yamhill	Wildwood	Met	Met		Did not meet		Did not meet	Slight impairment	
North Yamhill	Hawn (went dry)	Did not meet							
North Yamhill	Middle Turner	Met		Did not meet	Did not meet	Did not meet		Slight impairment	
North Yamhill	Lower Turner	Met	Met	Did not meet	Met	Did not meet		Moderate impairment	
North Yamhill	North Yamhill	Met	Met	Did not meet	Did not meet	Did not meet		Slight impairment	
North Yamhill	Panther	Did not meet	Met	Did not meet	Did not meet	Did not meet	Did not meet		Moderate impairment
North Yamhill	Baker								Slight impairment
Salt	Upper Salt	Met							
Salt	Middle Salt	Did not meet							
Salt	Lower Salt	Did not meet	Did not meet	Met		Met			
Upper South Yamhill	Cosper	Met	Met	Did not meet	Did not meet	Did not meet	Did not meet	Slight impairment	
Willamina	East	Met		Met	Met	Met	Met	Slight impairment	
Willamina	Coast	Met		Met	Met	Met	Did not meet	Slight impairment	
Willamina	Willamina	Met	Met	Met	Did not meet	Did not meet	Did not meet	Slight impairment	

[26] Sites are organized upstream to downstream within each subwatershed.
[27] $=10^{((LOG_{10}(A)+LOG_{10}(B)+LOG_{10}(C)+LOG_{10}(D)+LOG_{10}(E))/5)}$, where A-E are the number of cells/100mL in five samples collected over 30 days.
[28] MPN of cells using a Quanti-Tray Enumeration Test Procedure.
[29] A multi-metric value determined by taxa richness, mayfly richness, stonefly richness, caddisfly richness, sensitive taxa, sediment sensitive taxa, modified HBI (indicator of organic enrichment), % tolerant taxa, % sediment tolerant and % dominant taxa.
[30] <20 = severe impairment, 20-30 = moderate impairment, 30-40 = slight impairment, >40 = no impairment.

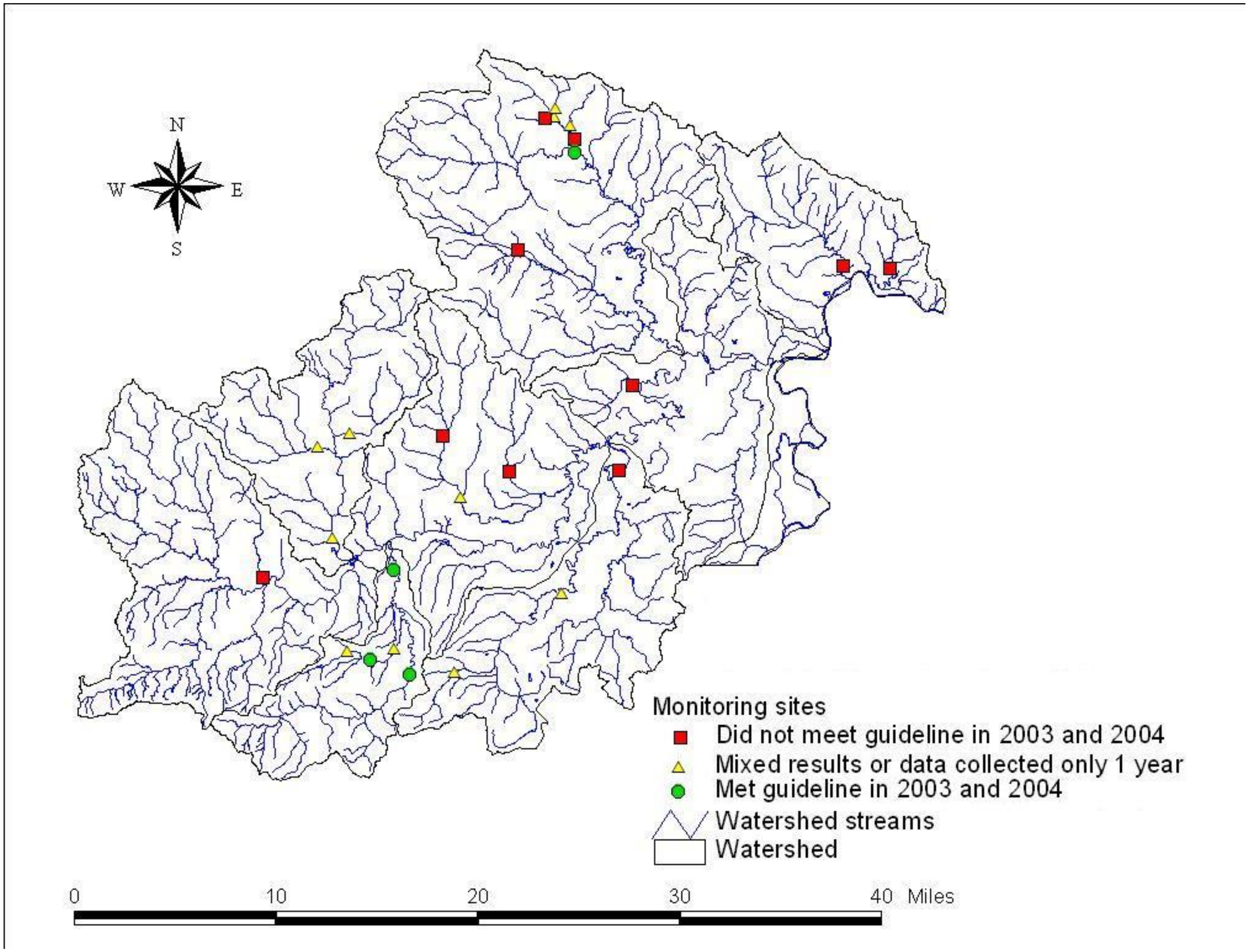
Map 5.1 Temperature Results From 2003 and 2004.



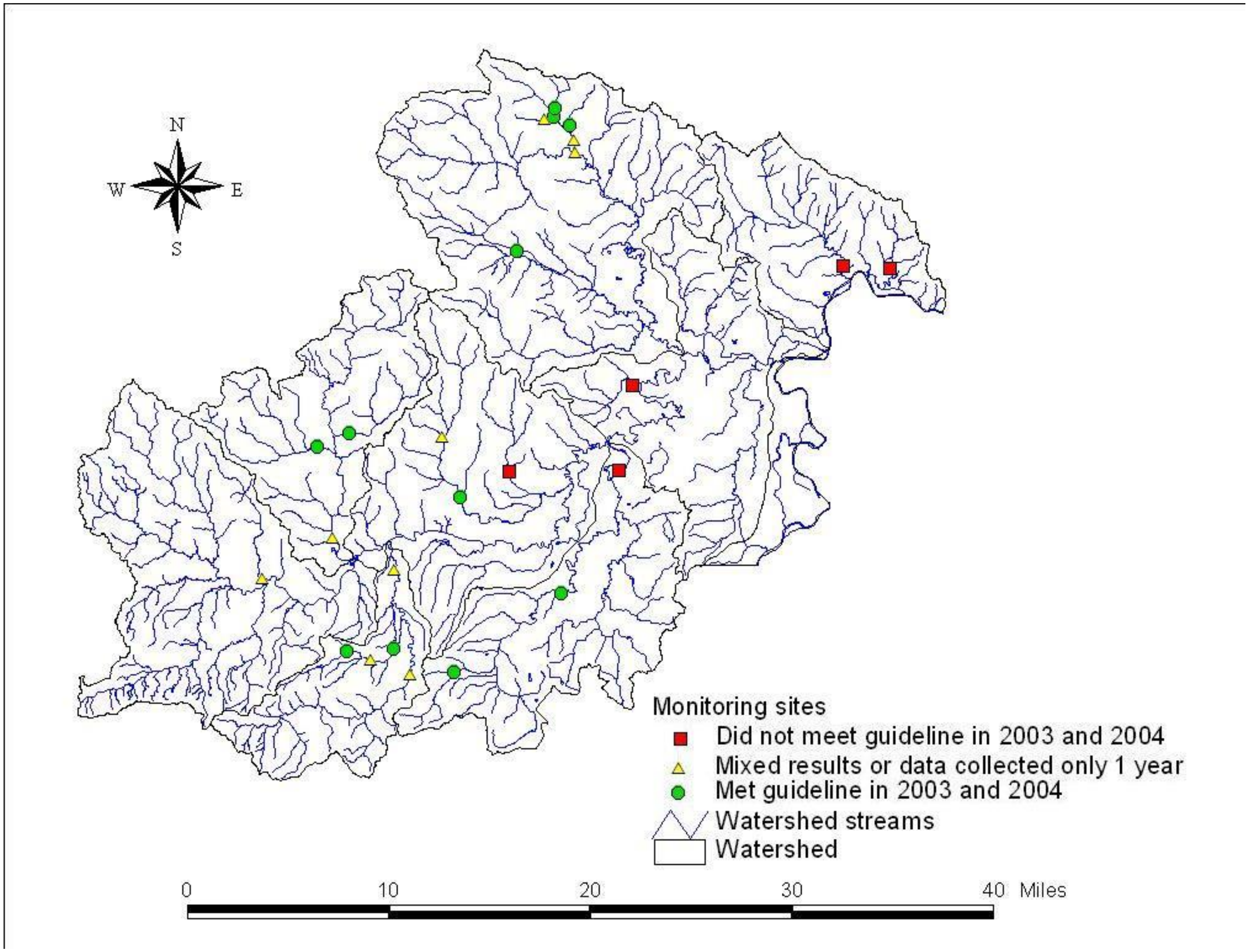
Map 5.2 Dissolved Oxygen Results From 2003 and 2004.



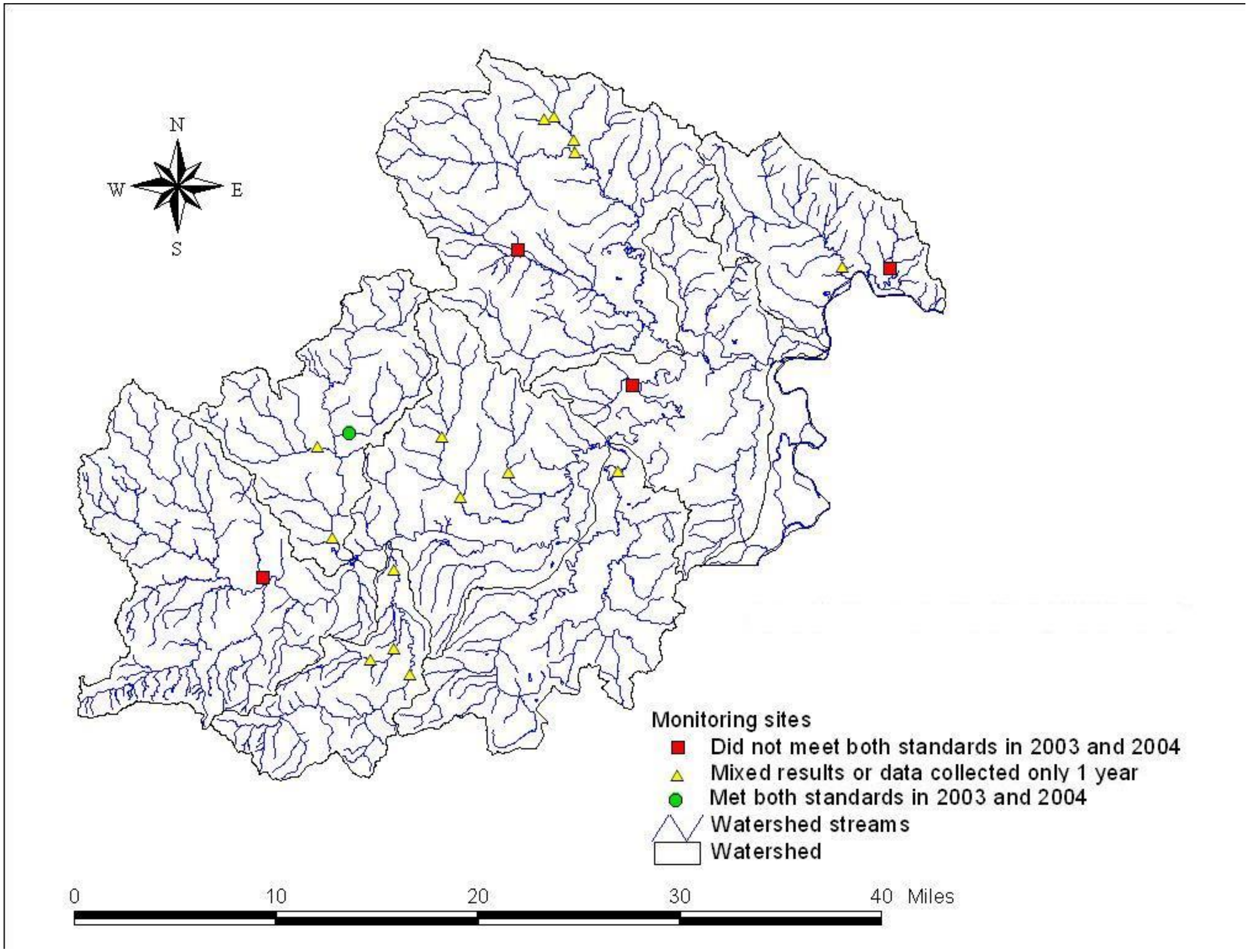
Map 5.3 Turbidity Results From 2003 and 2004.



Map 5.4 Conductivity Results From 2003 and 2004.



Map 5.5 *E. coli* results From 2003 and 2004.



Map 5.6 Benthic Macroinvertebrate Results From 2003 and 2004.

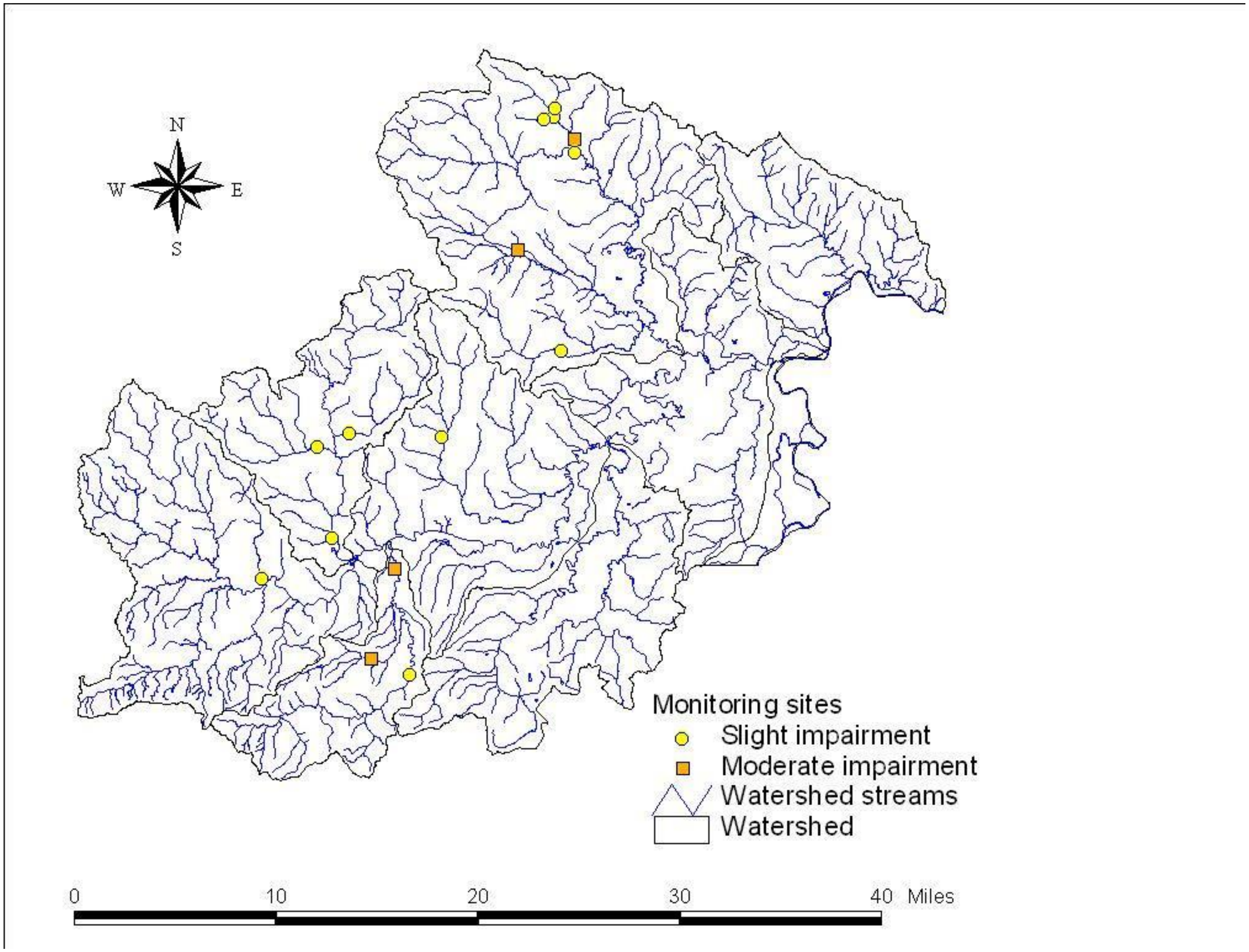


Table 5.4 Highest and Lowest 2003 and 2004 Monitoring Values.

	2003 Monitoring			2004 Monitoring		
Parameter	**Subwatershed**	**Site**	**Value**	**Subwatershed**	**Site**	**Value**
Highest 7-day temperature average	Mill	Lower Mill Creek	80.4 F	Chehalem	Chehalem Creek	77.9 F
Lowest 7-day temperature average	Mill	Upper Gooseneck Creek	59.9 F	Mill	Upper Gooseneck Creek	61.3 F
Most hours above 64.4F	Mill	Lower Mill Creek	1758.5 hours	Chehalem	Chehalem Creek	1881 hours
Fewest hours above 64.4F	Mill	Upper Gooseneck Creek	0.5 hours	Mill	Upper Gooseneck Creek	0 hours
Highest average dissolved oxygen	North Yamhill Willamina	North Yamhill River Coast Creek	9.8 mg/L 9.8 mg/L	Mill	Upper Mill Creek	9.8 mg/L
Lowest average dissolved oxygen	Salt	Lower Salt Creek	4.5 mg/L	Salt	Lower Salt Creek	3.3 mg/L
Highest average turbidity	Salt	Middle Salt Creek	14.8 NTU	Chehalem	Spring Brook	13.0 NTU
Lowest average turbidity	Mill	Upper Mill Creek	0.6 NTU	Mill	Upper Mill Creek	0.6 NTU
Highest average pH	North Yamhill North Yamhill	North Yamhill River Middle Turner Creek	7.9 7.9	North Yamhill	North Yamhill River	7.9
Lowest average pH	North Yamhill	Hawn Creek	7.2	Salt	Lower Salt Creek	7.4
Highest average conductivity	Lower Yamhill	Cozine Creek	457.6 mhos/cm	Lower Yamhill	Cozine Creek	371.5 mhos/cm
Lowest average conductivity	Willamina	Coast Creek	89.8 mhos/cm	Mill	Upper Mill Creek	75.1 mhos/cm
Highest geomean *E. coli*	North Yamhill	Panther Creek	1514 MPN/100 mL	North Yamhill	Panther Creek	922 MPN/100 mL
Lowest geomean *E. coli*	Salt	Lower Salt Creek	17 MPN/100 mL	Willamina	East Creek	58 MPN/100 mL
Highest B-IBI score for benthic macroinvertebrates	Willamina	Coast Creek	B-IBI 38	North Yamhill	Baker Creek	B-IBI 34
Lowest B-IBI score for benthic macroinvertebrates	Mill	Lower Mill Creek	B-IBI 26	North Yamhill	Panther	B-IBI 26

Figure 5.1 Chehalem Creek Subwatershed 2003 7-Day Average Temperature Results.

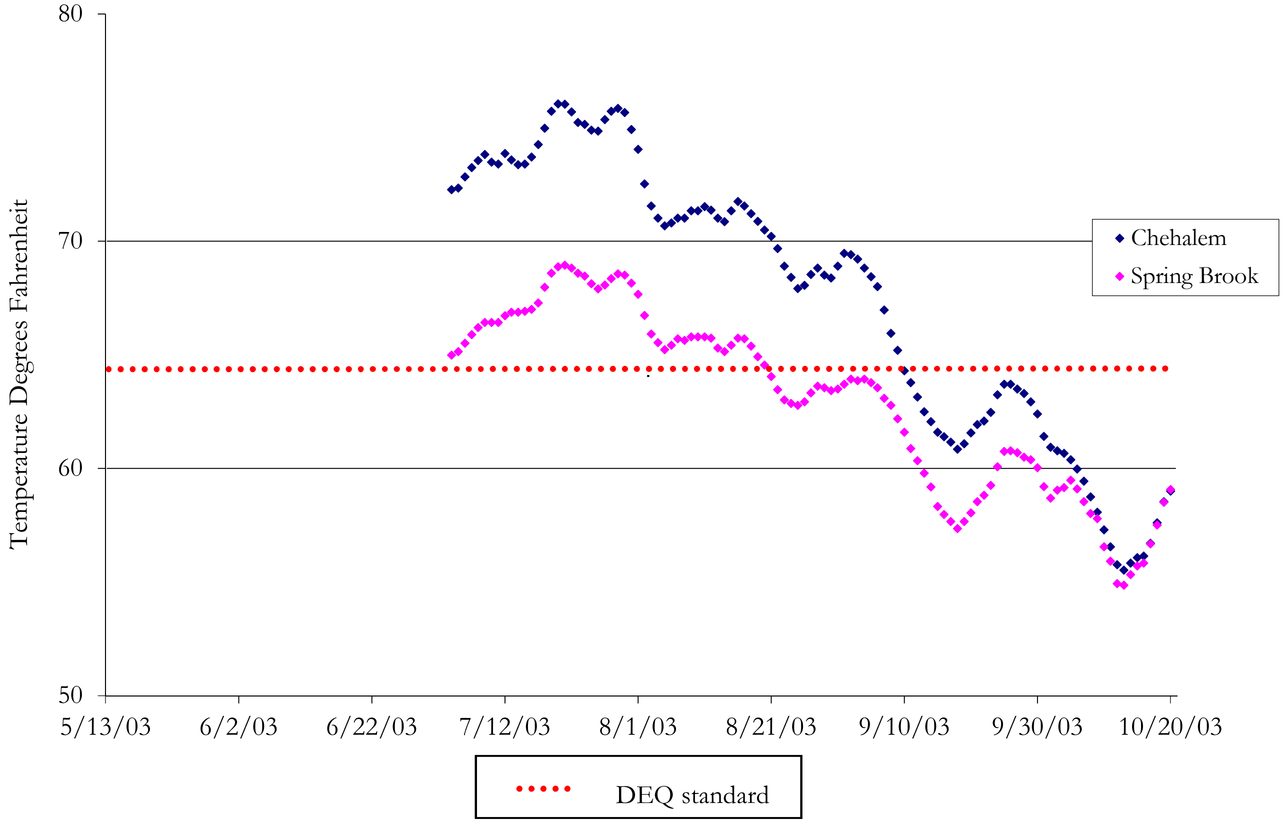


Figure 5.2 Chehalem Creek Subwatershed 2004 7-Day Average Temperature Results.

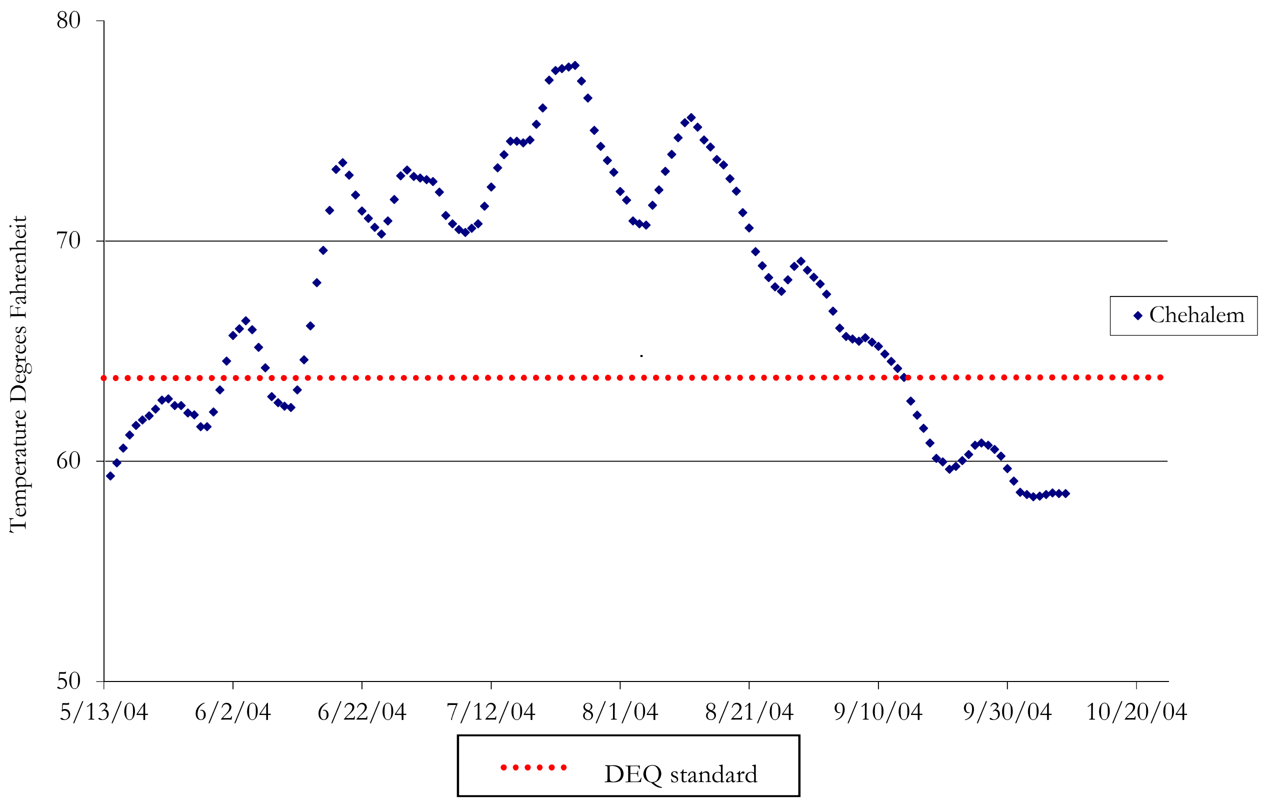


Figure 5.3 Lower South Yamhill River Subwatershed 2003 7-Day Average Temperature Results.

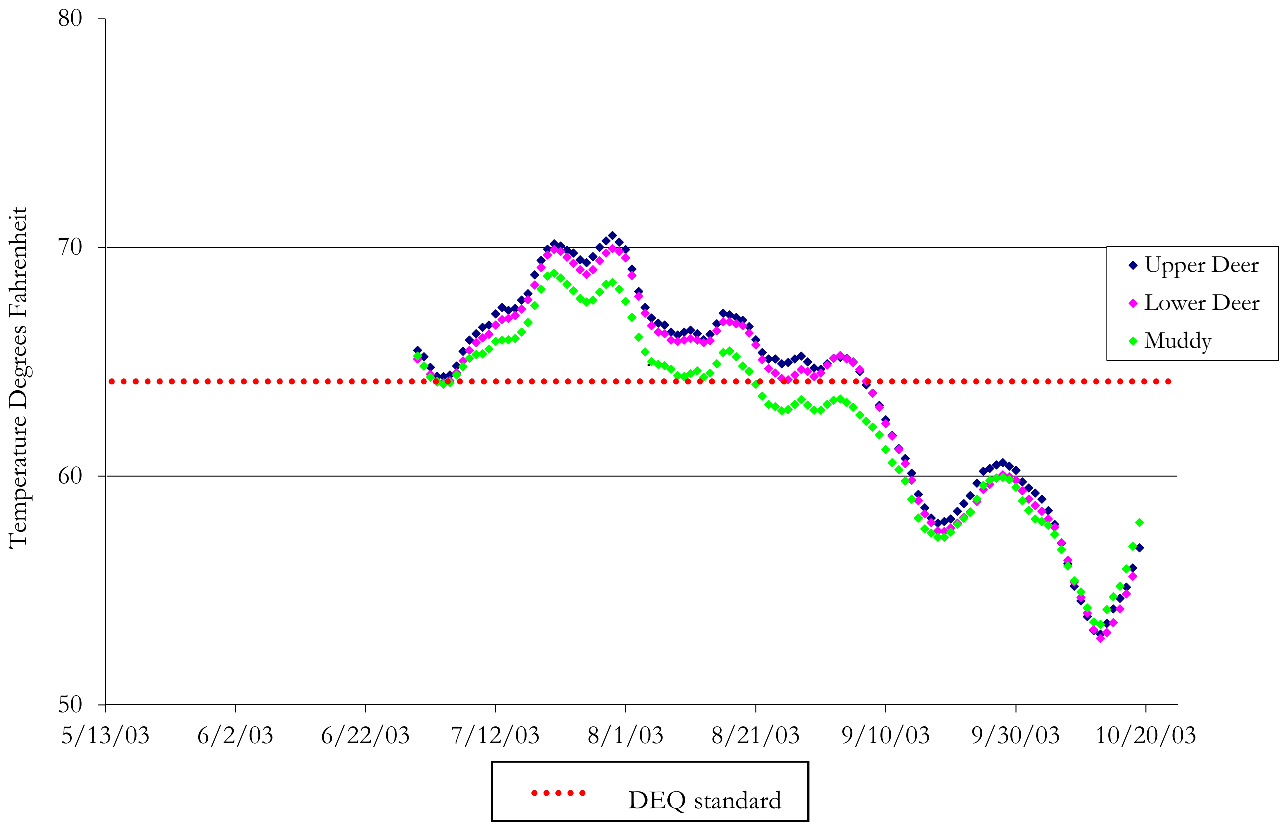


Figure 5.4 Lower South Yamhill River Subwatershed 2004 7-Day Average Temperature Results.

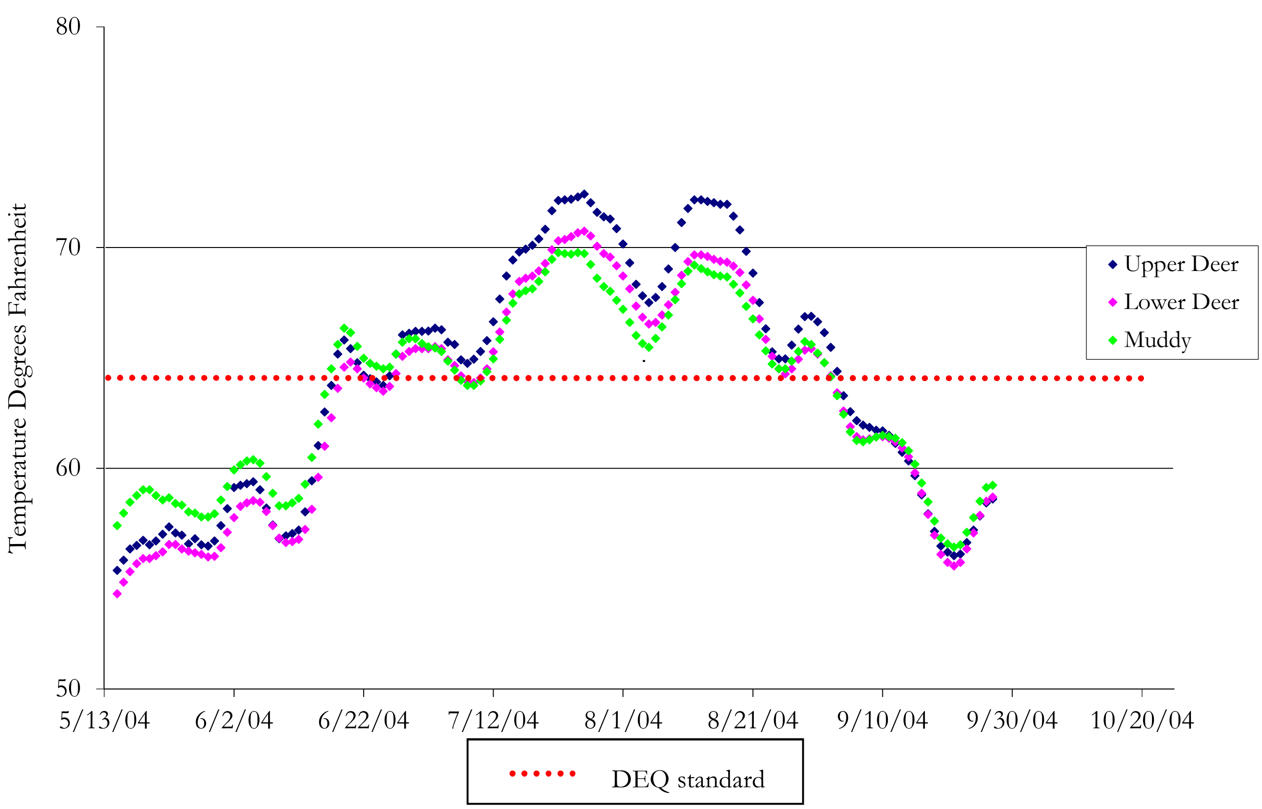


Figure 5.5 Lower Yamhill River Subwatershed 2003 7-Day Average Temperature Results.

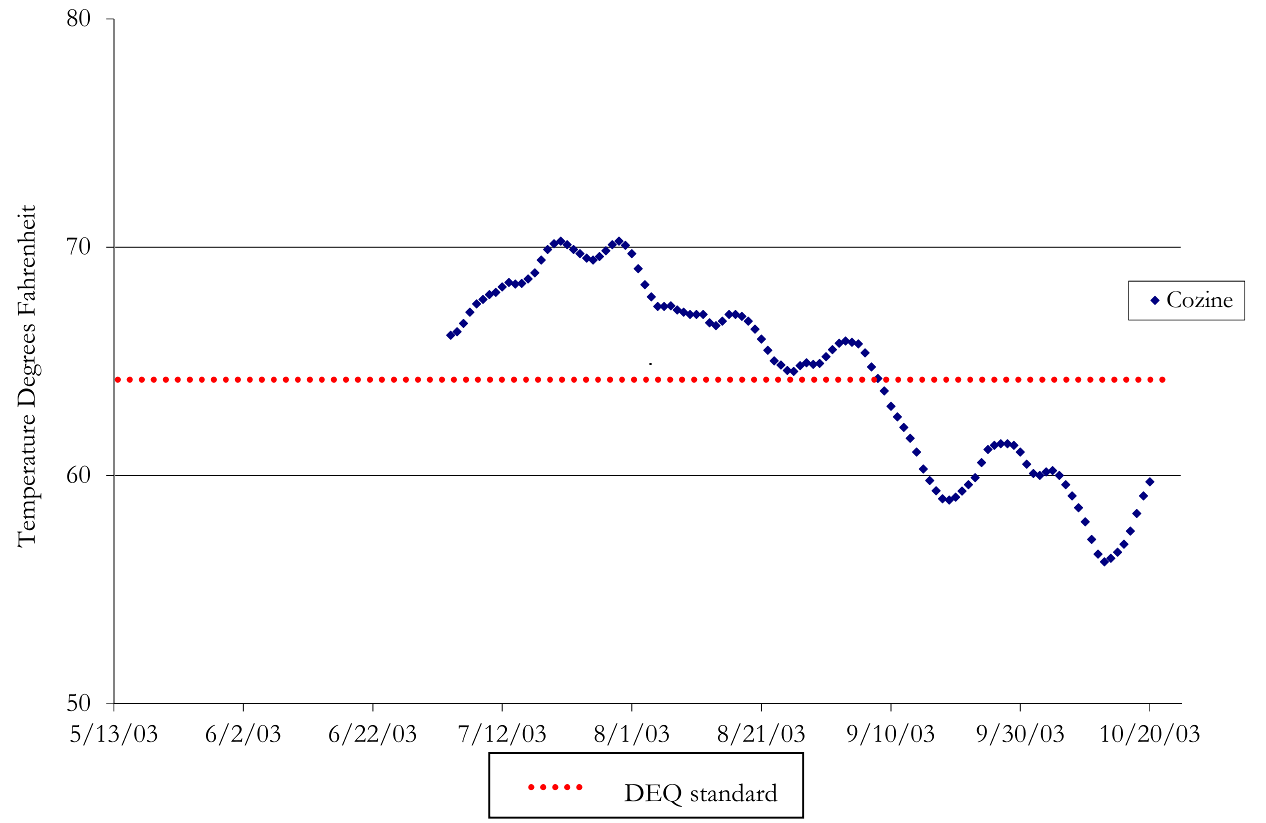


Figure 5.6 Lower Yamhill River Subwatershed 2004 7-Day Average Temperature Results.

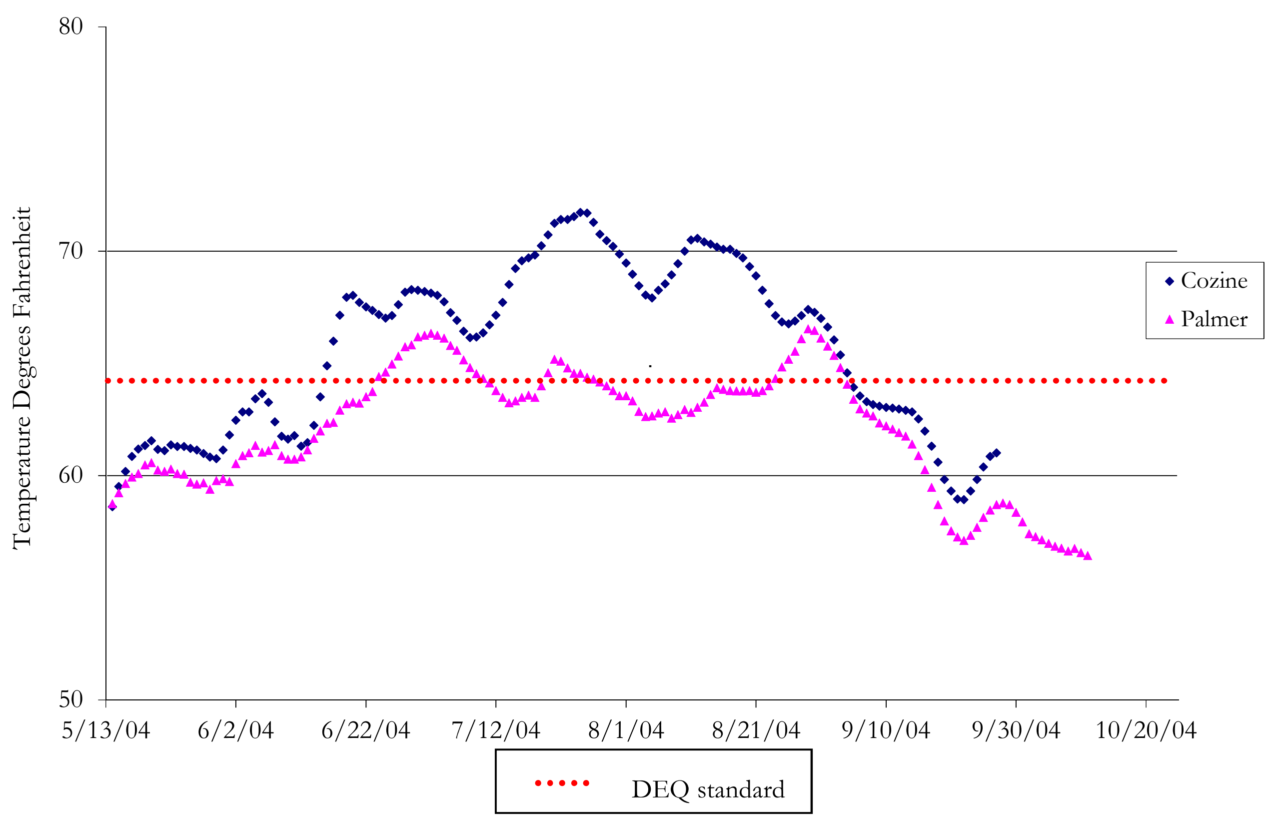


Figure 5.7 Mill Creek Subwatershed 2003 7-Day Average Temperature Results.

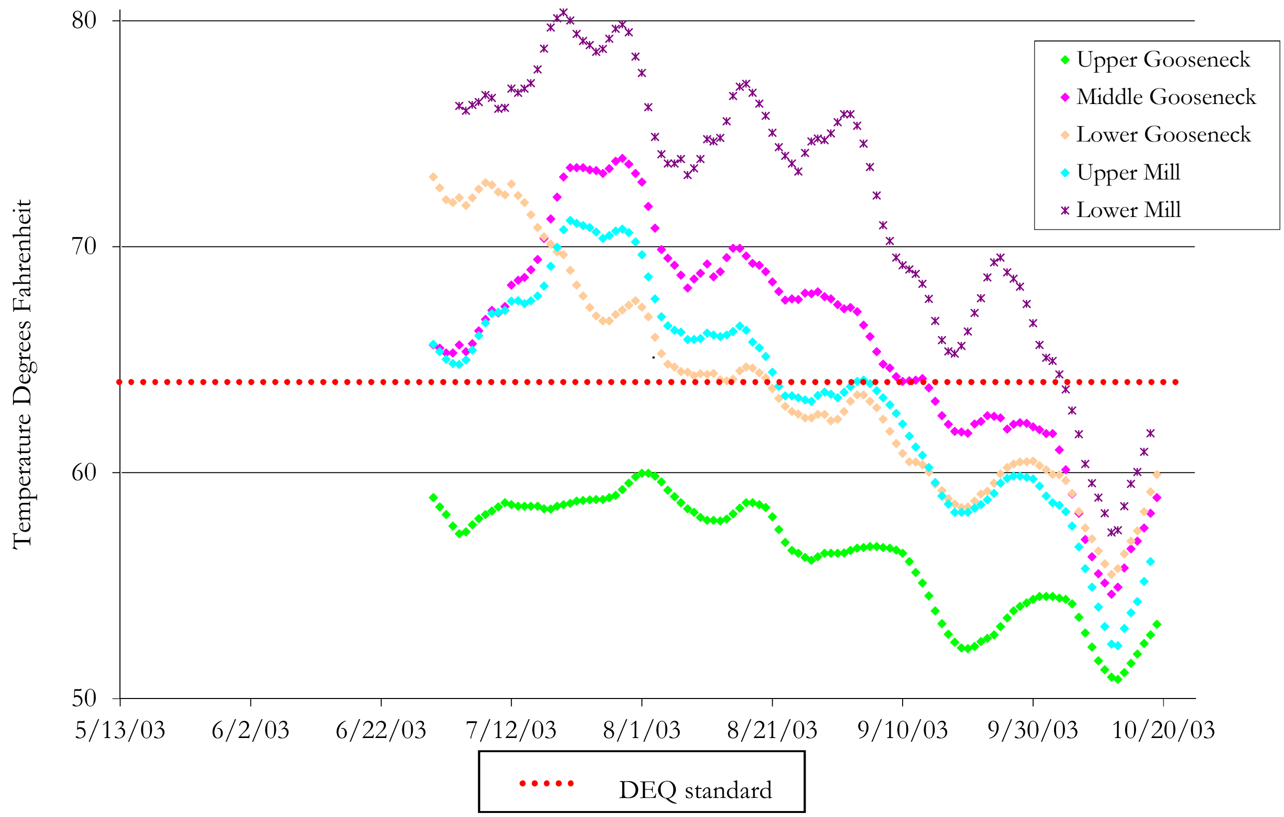


Figure 5.8 Mill Creek Subwatershed 2004 7-Day Average Temperature Results.

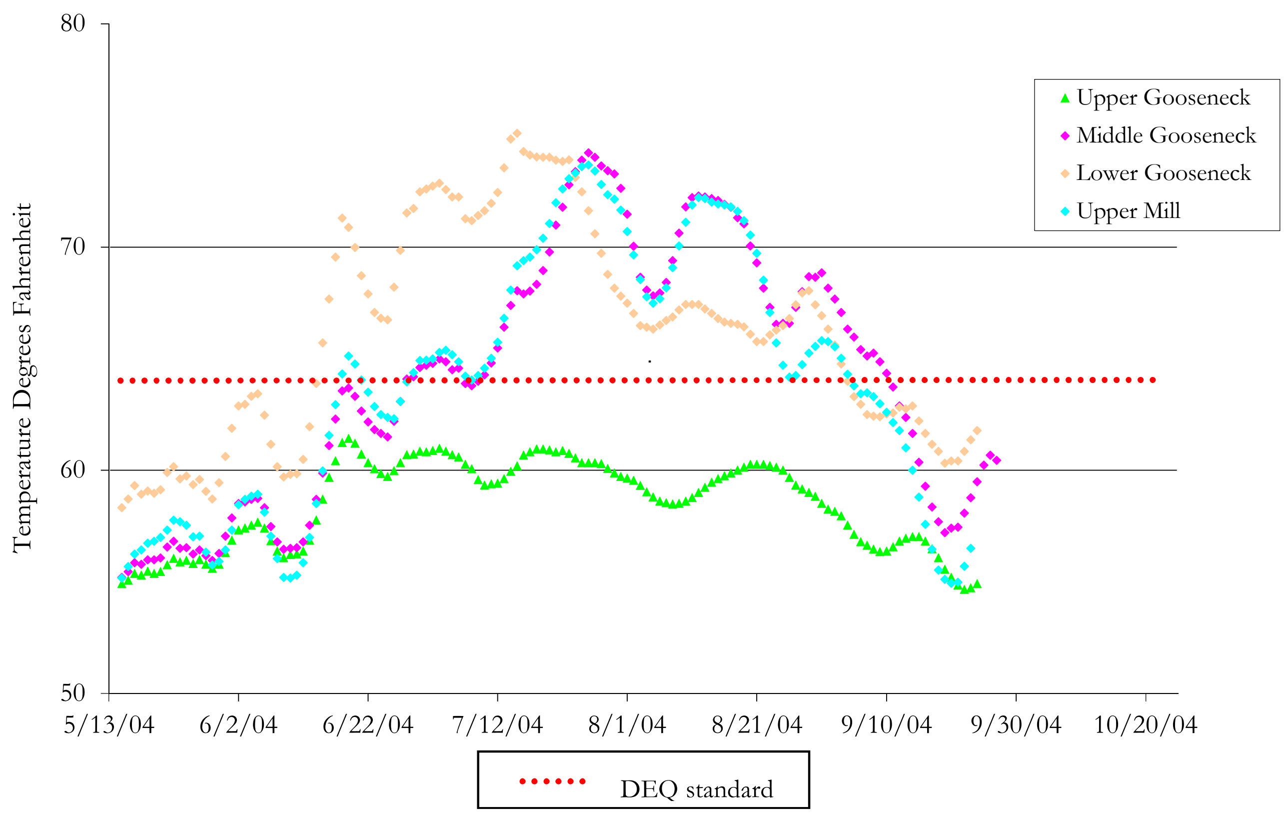


Figure 5.9 North Yamhill River Subwatershed 2003 7-Day Average Temperature Results.

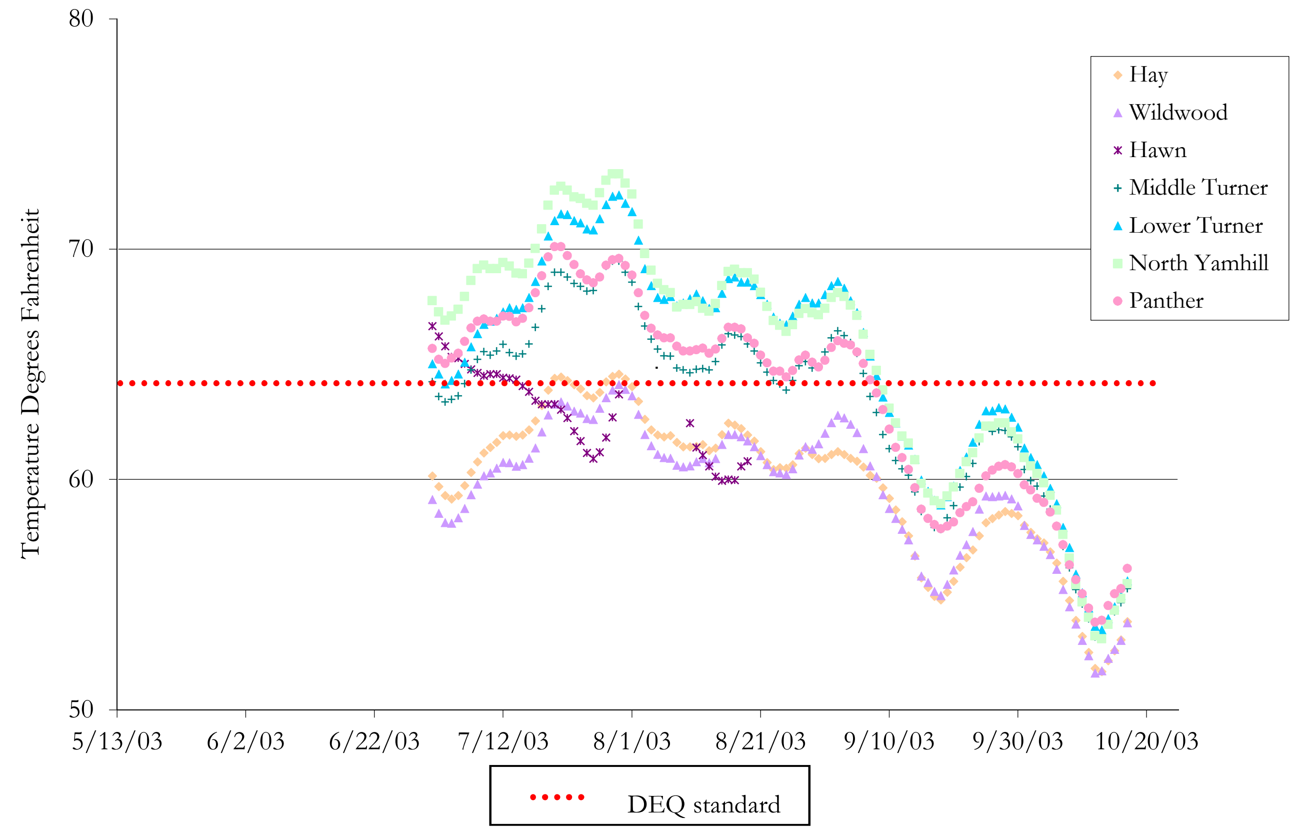


Figure 5.10 North Yamhill River Subwatershed 2004 7-Day Average Temperature Results.

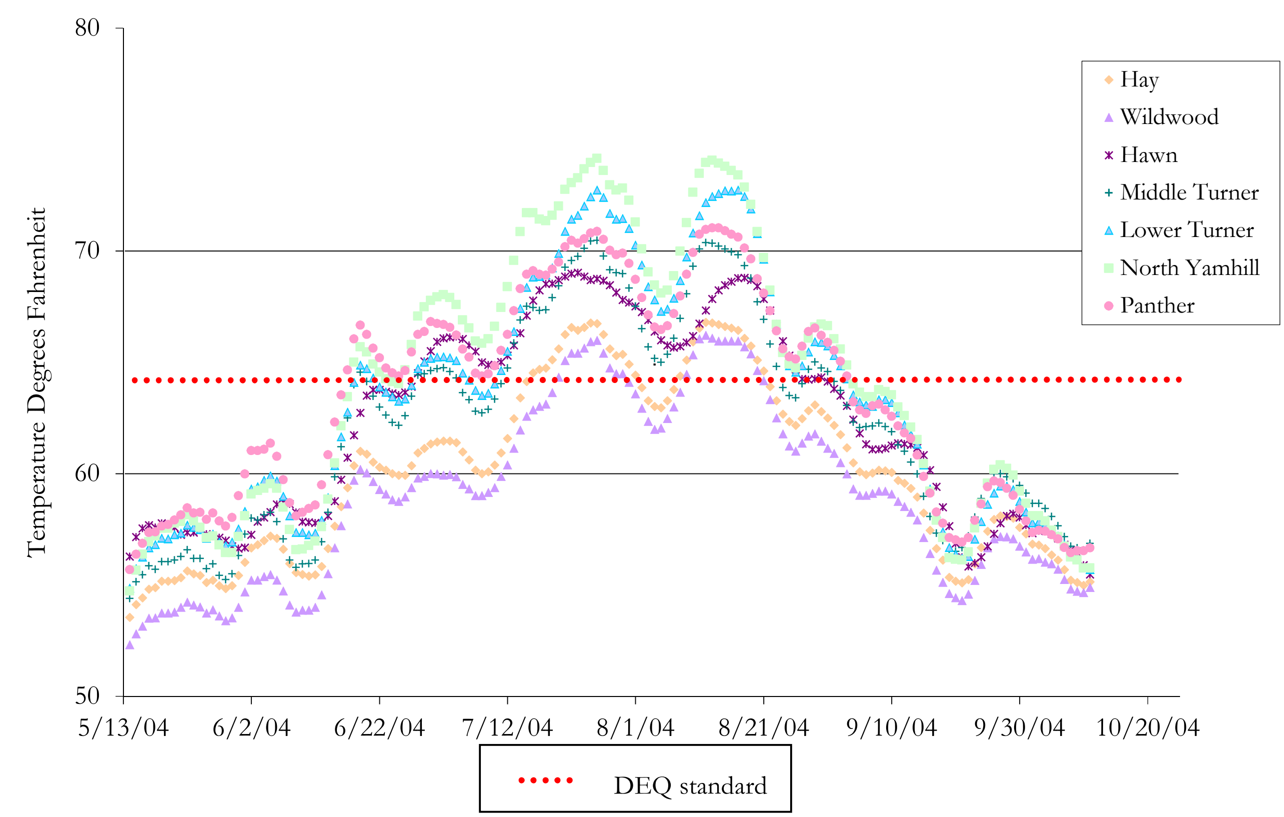


Figure 5.11 Salt Creek Subwatershed 2003 7-Day Average Temperature Results.

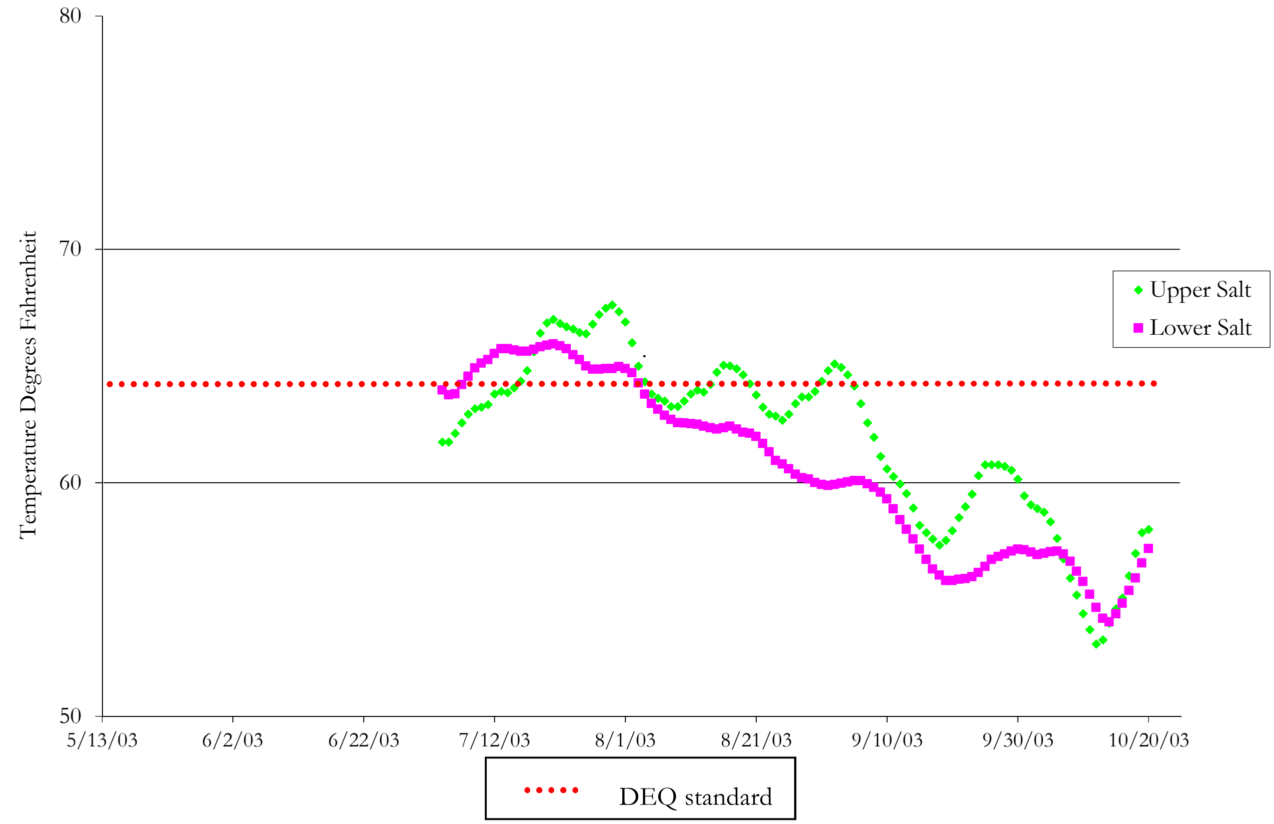


Figure 5.12 Salt Creek Subwatershed 2004 7-Day Average Temperature Results.

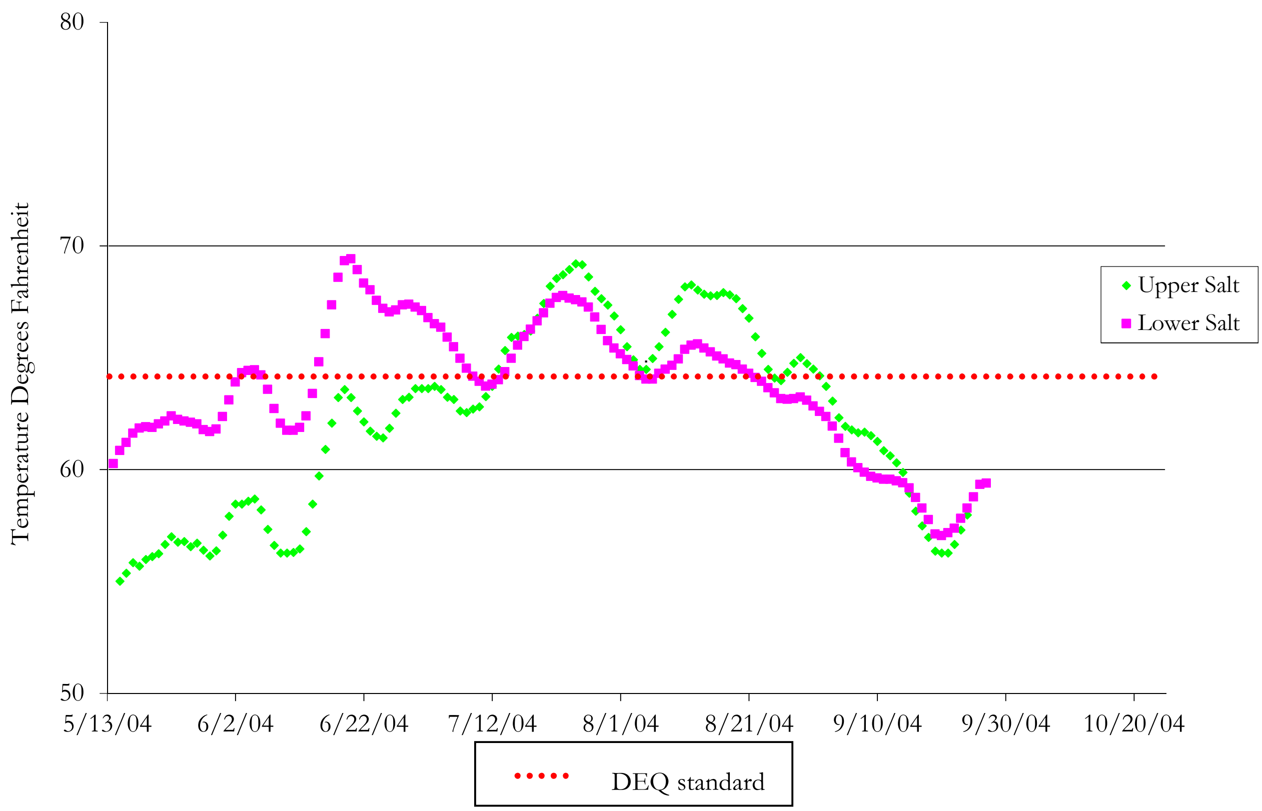


Figure 5.13 Upper South Yamhill River Subwatershed 2003 7-Day Average Temperature Results.

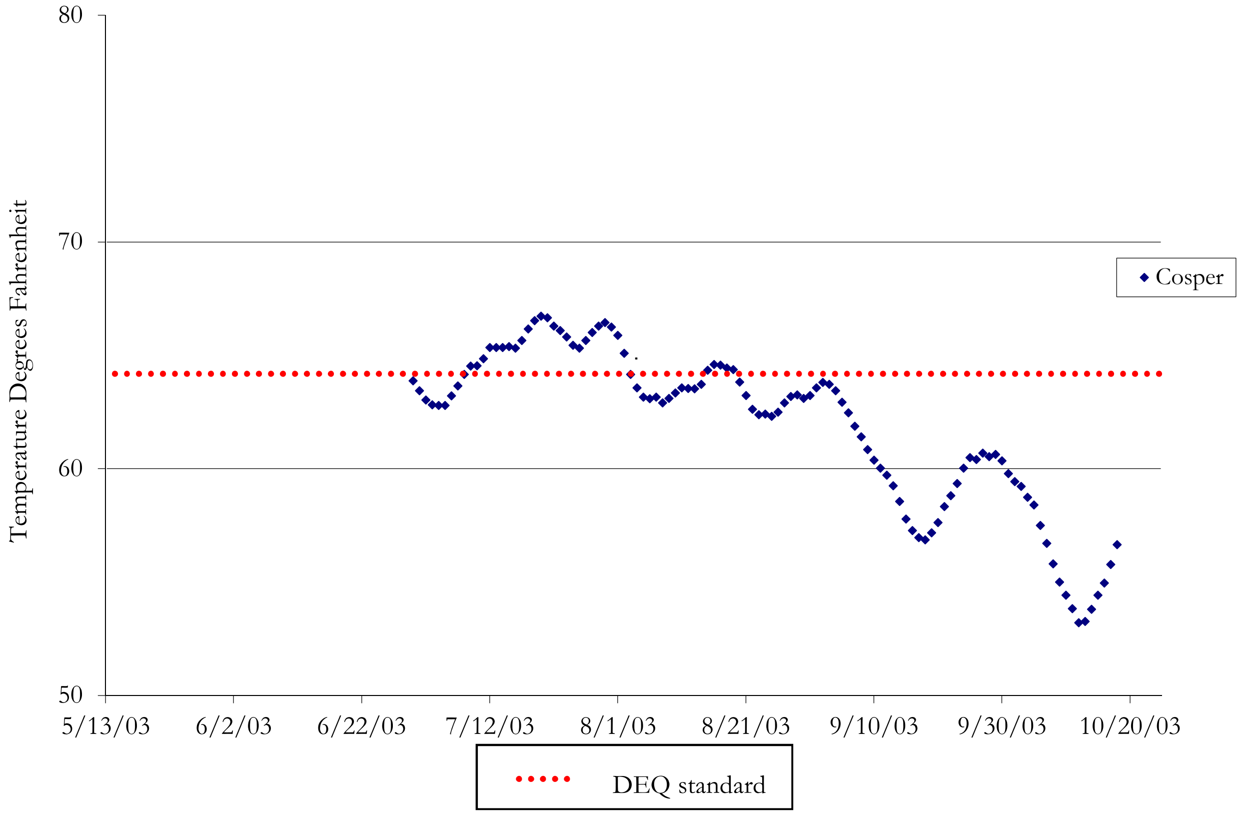


Figure 5.14 Upper South Yamhill River Subwatershed 2004 7-Day Average Temperature Results.

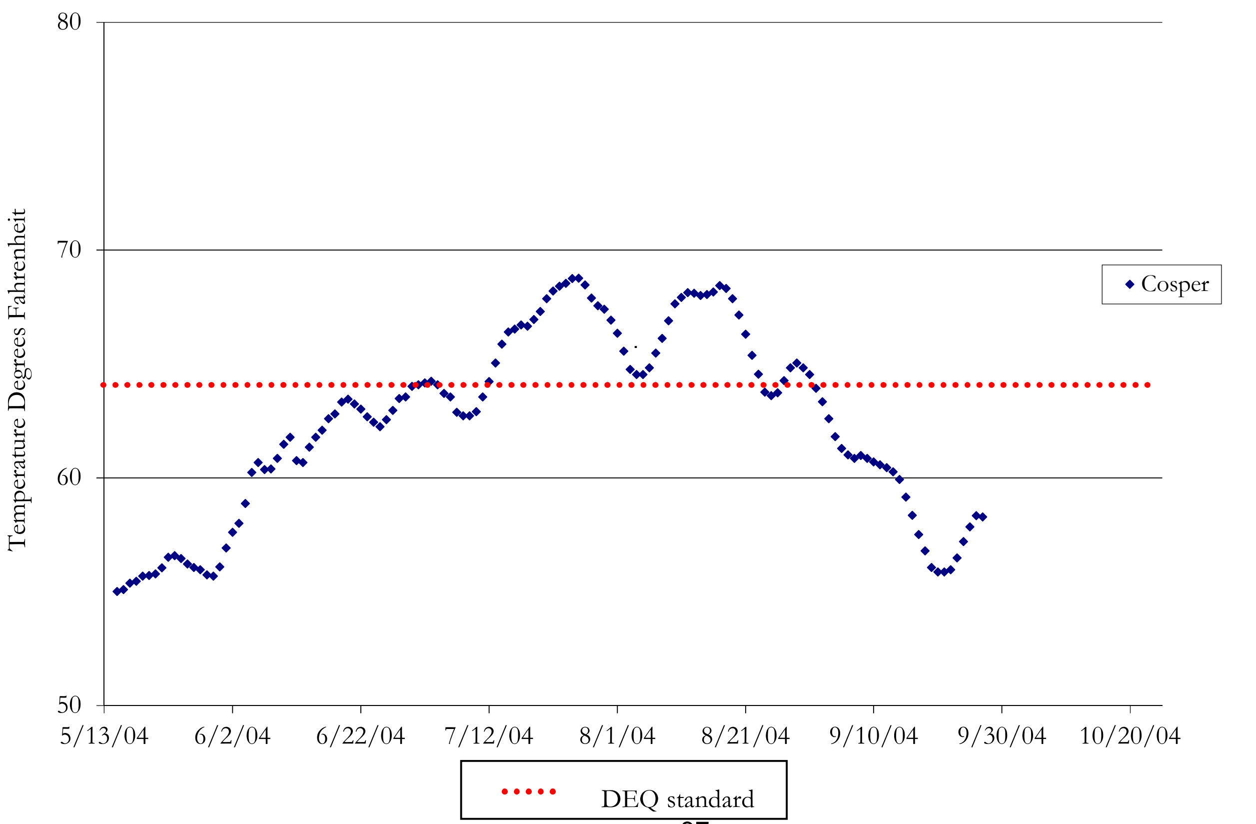


Figure 5.15 Willamina Creek Subwatershed 2003 7-Day Average Temperature Results.

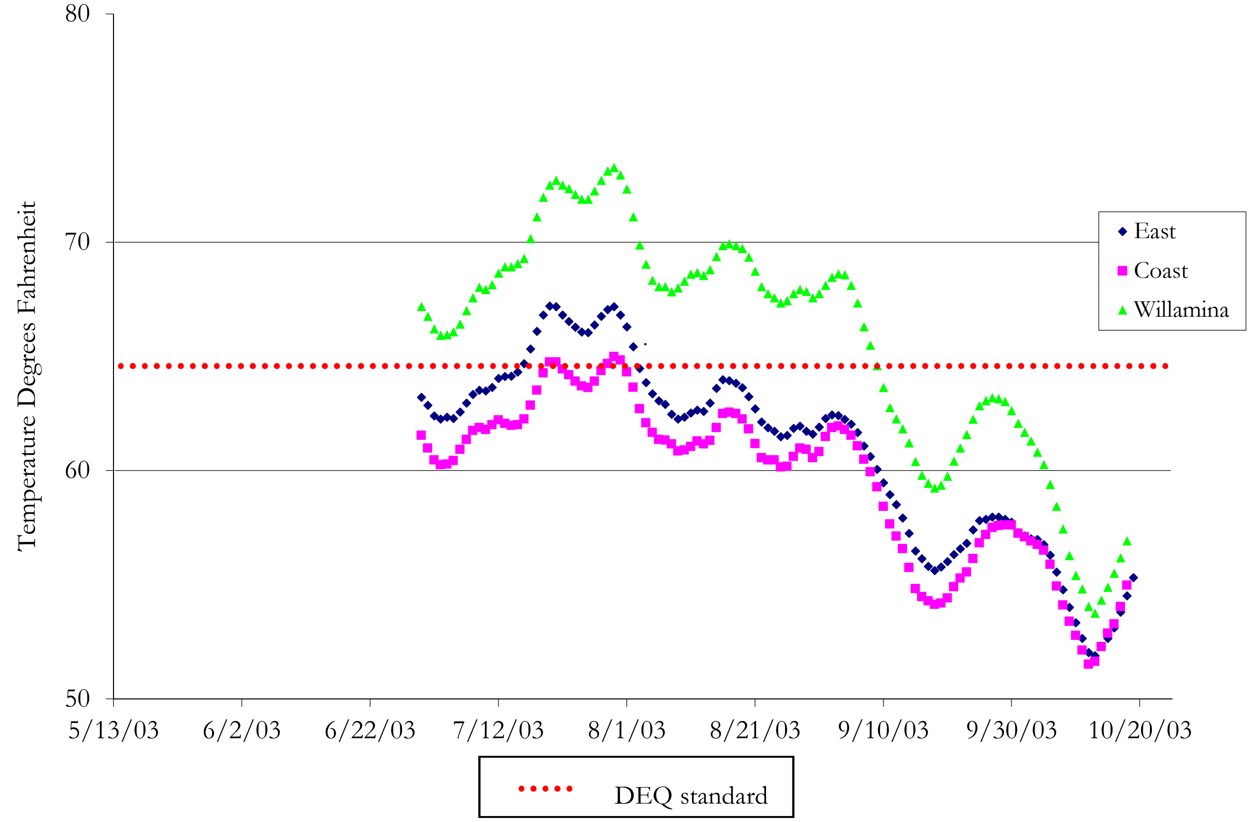


Figure 5.16 Willamina Creek Subwatershed 2004 7-Day Average Temperature Results.

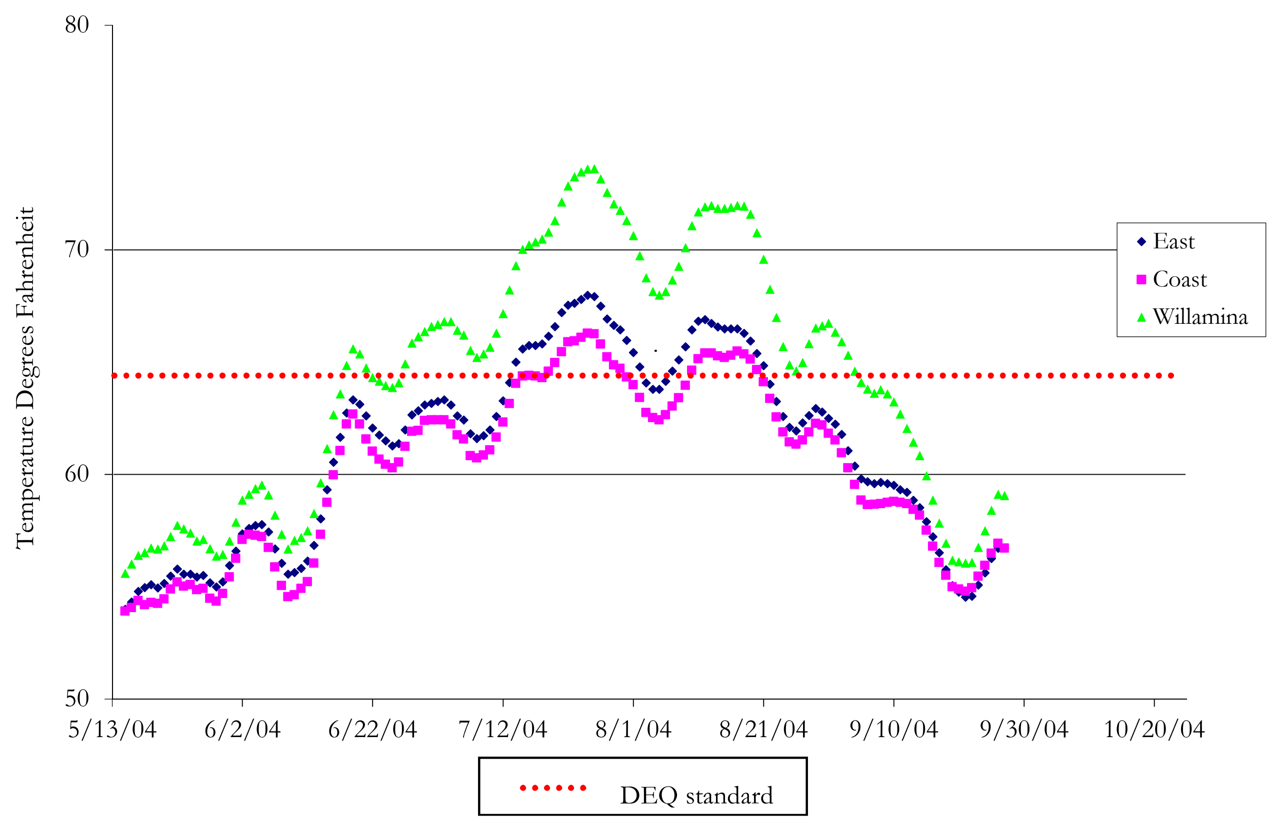


Figure 5.17 Dissolved Oxygen 2004 Min-Max Results

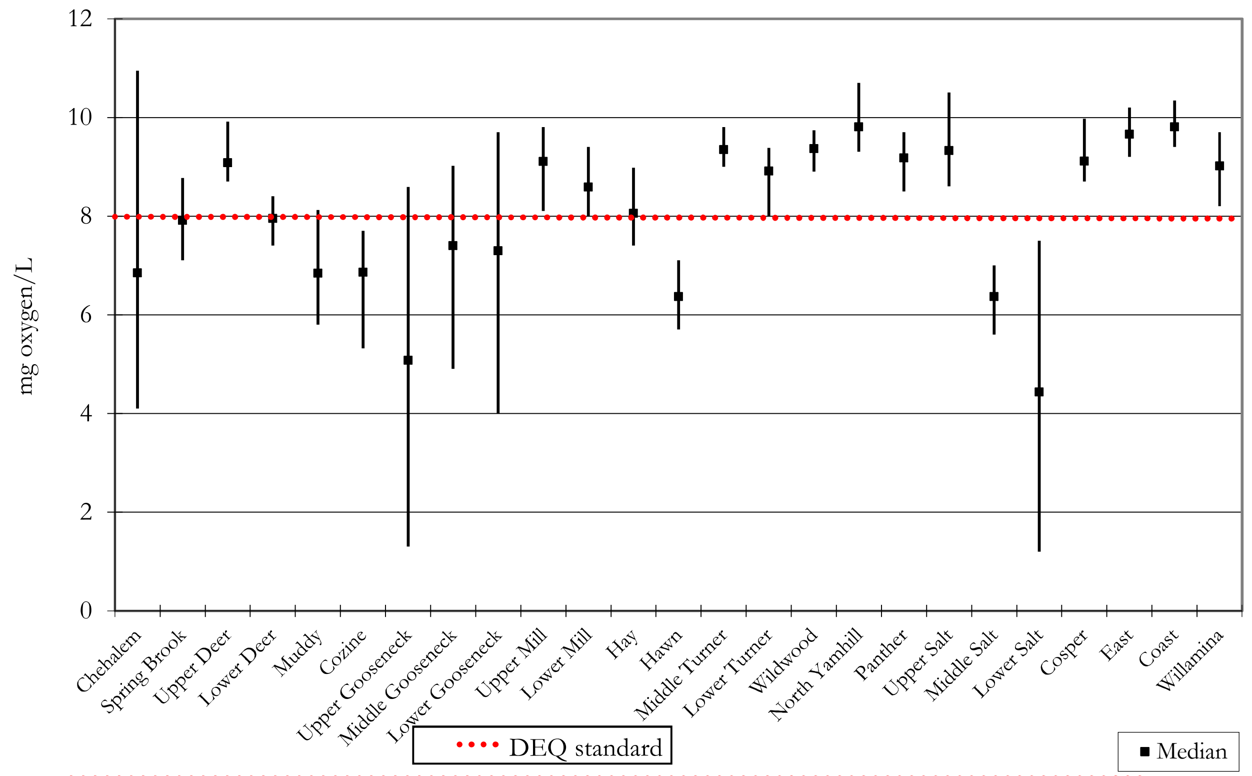


Figure 5.18 Dissolved Oxygen 2004 Min-Max Results

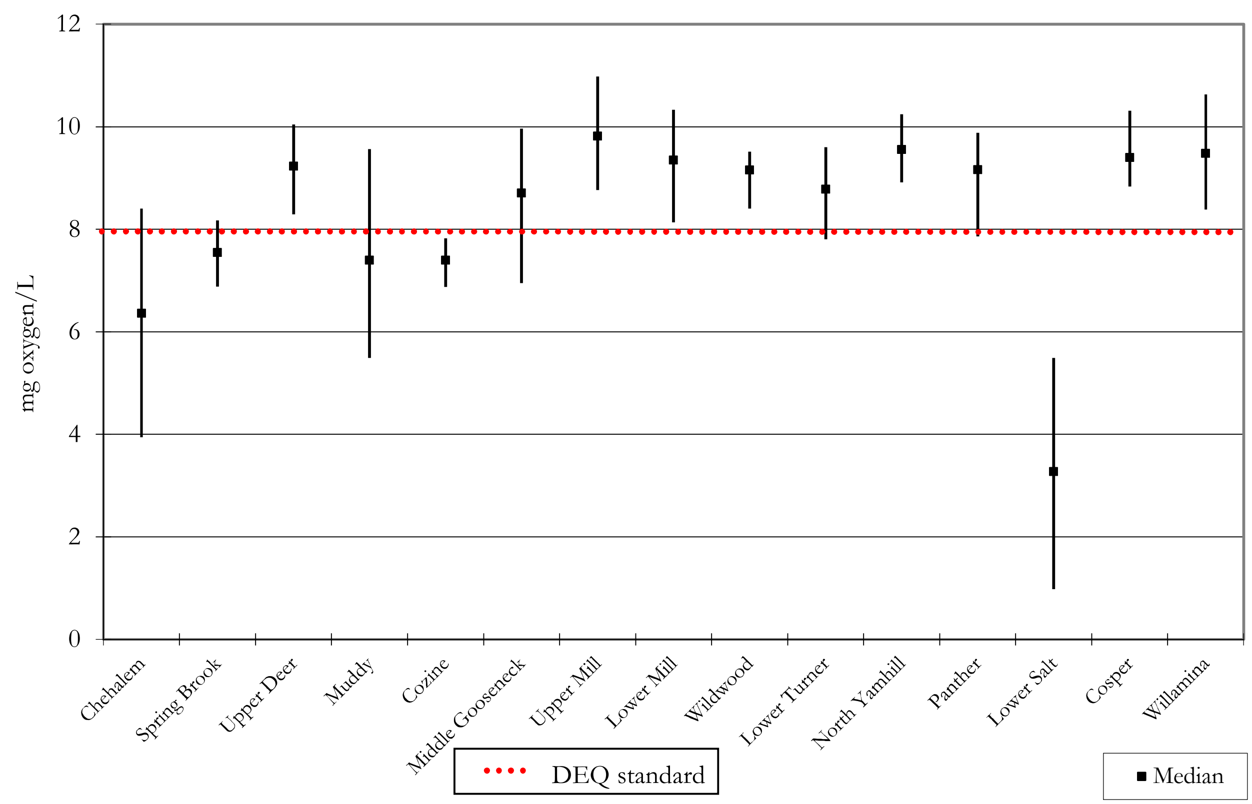


Figure 5.19 Turbidity 2003 Min-Max Results

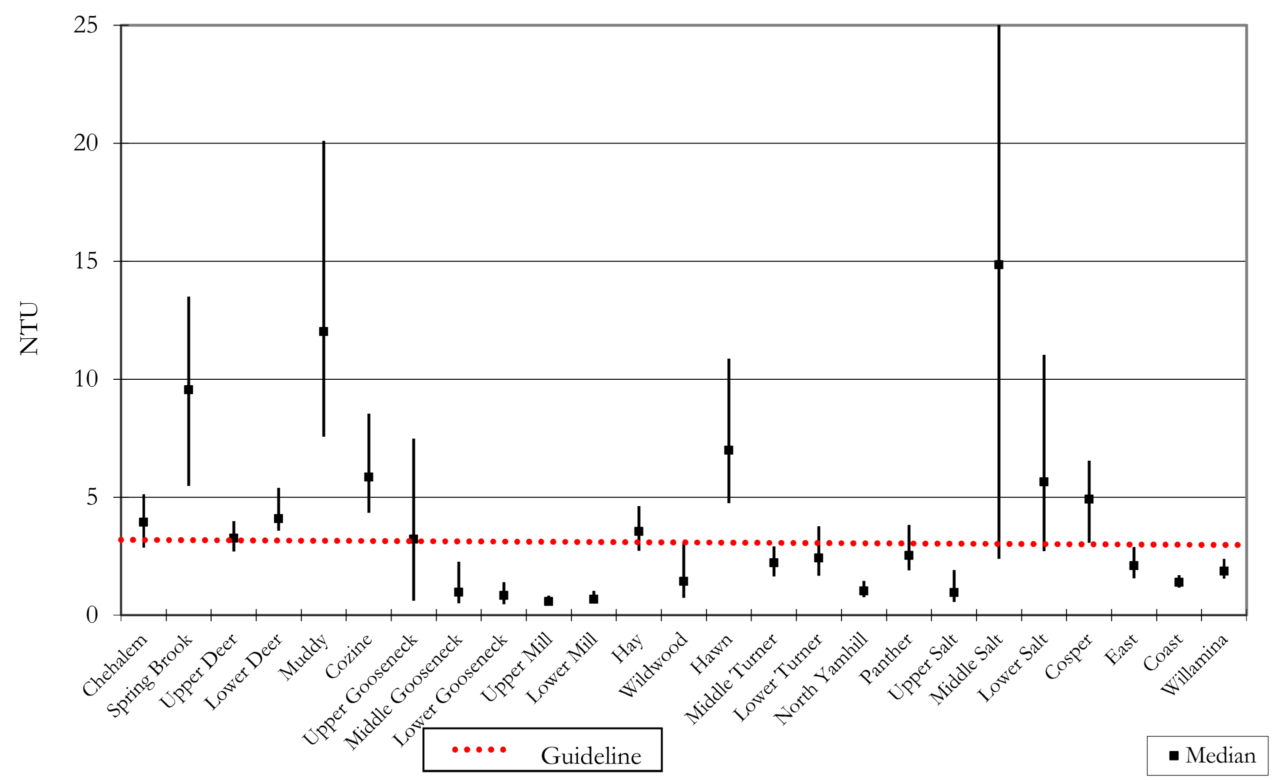


Figure 5.20 Turbidity 2004 Min-Max Results

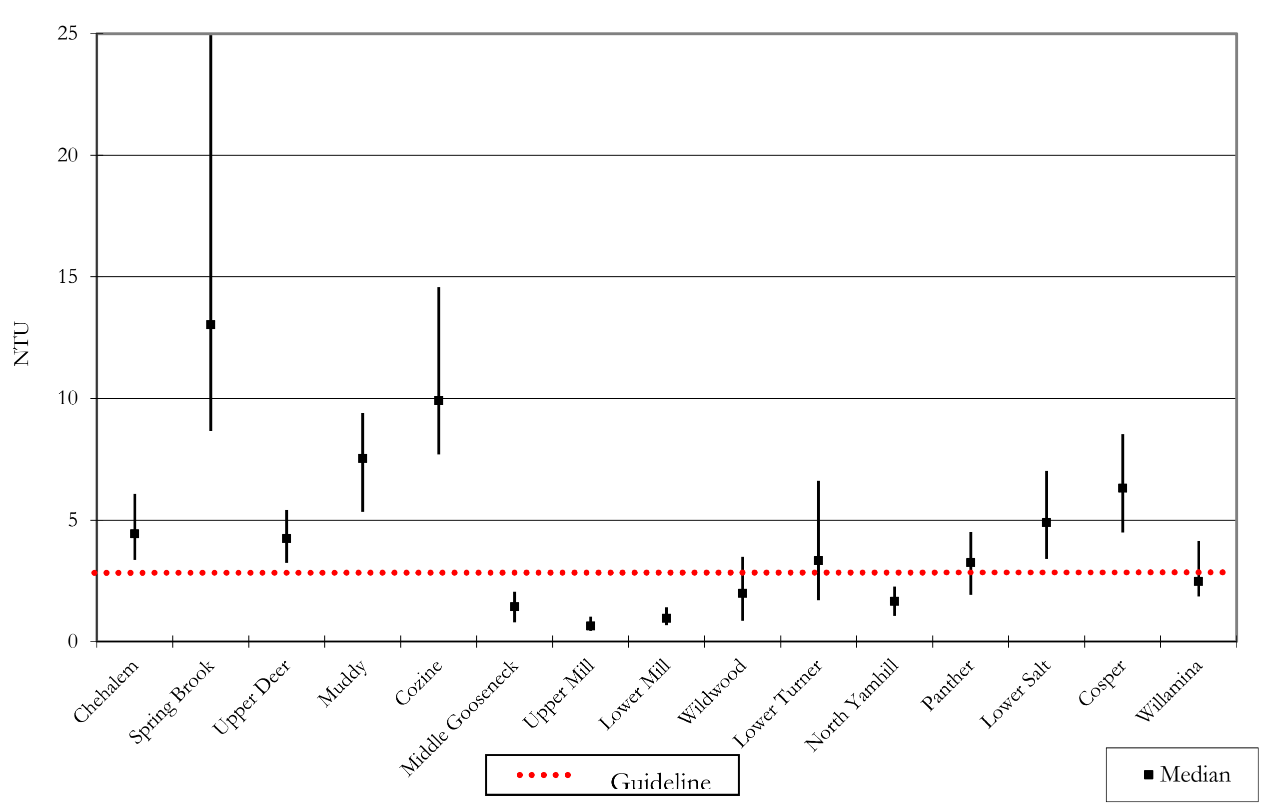


Figure 5.21 pH 2003 Min-Max Results

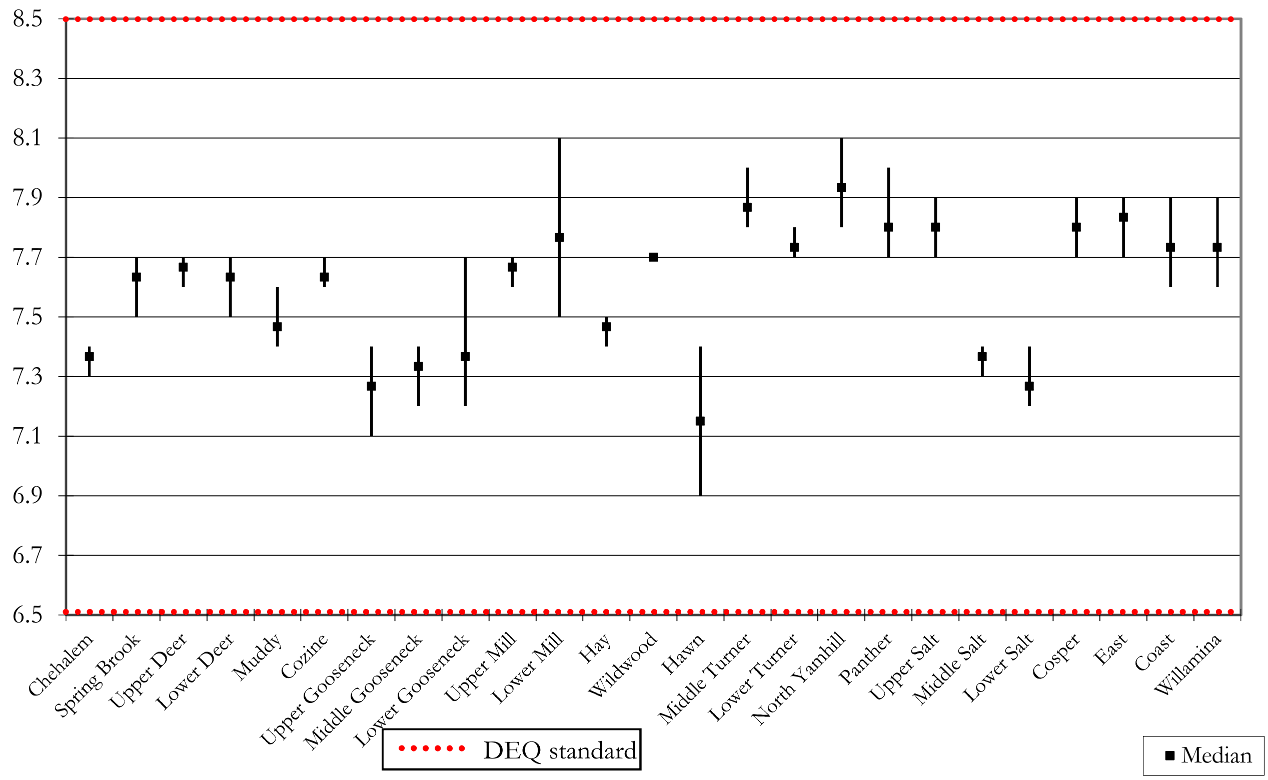


Figure 5.22 pH 2004 Min-Max Results

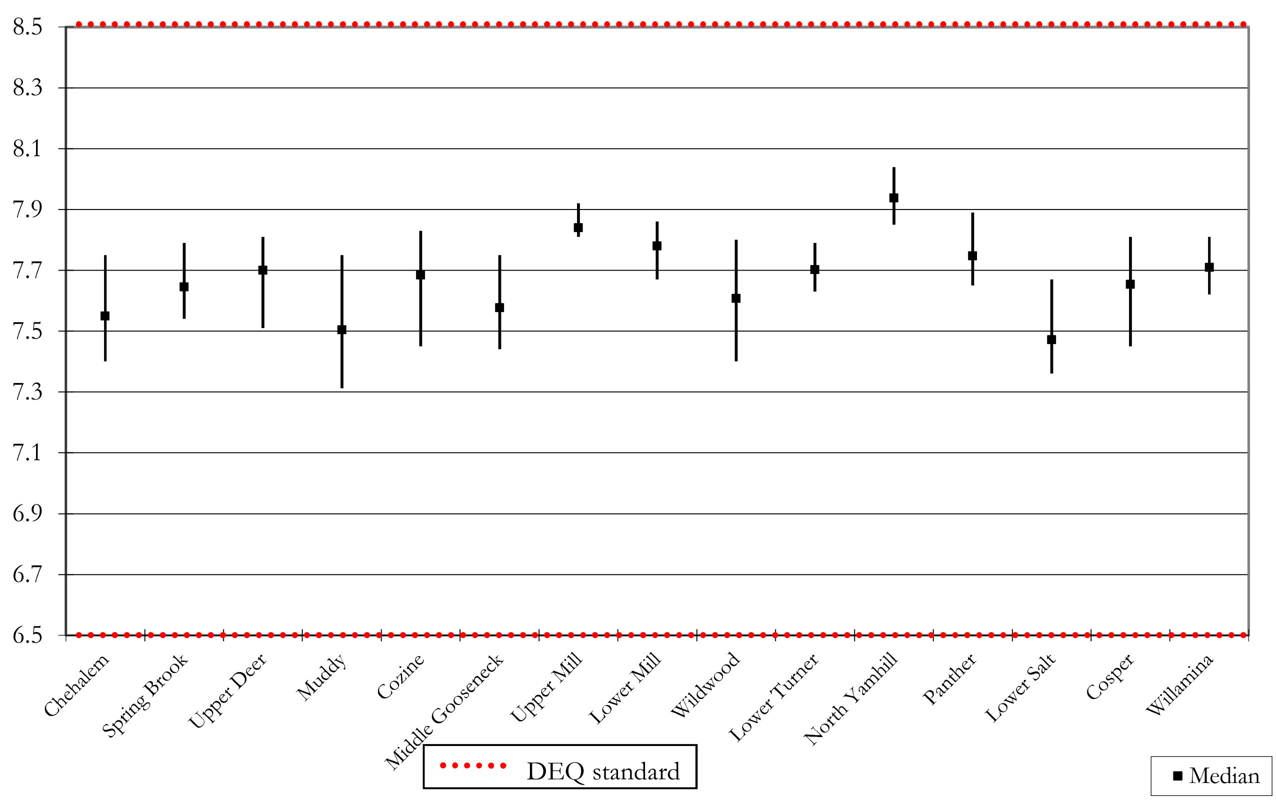


Figure 5.23 Conductivity 2003 Min-Max Results

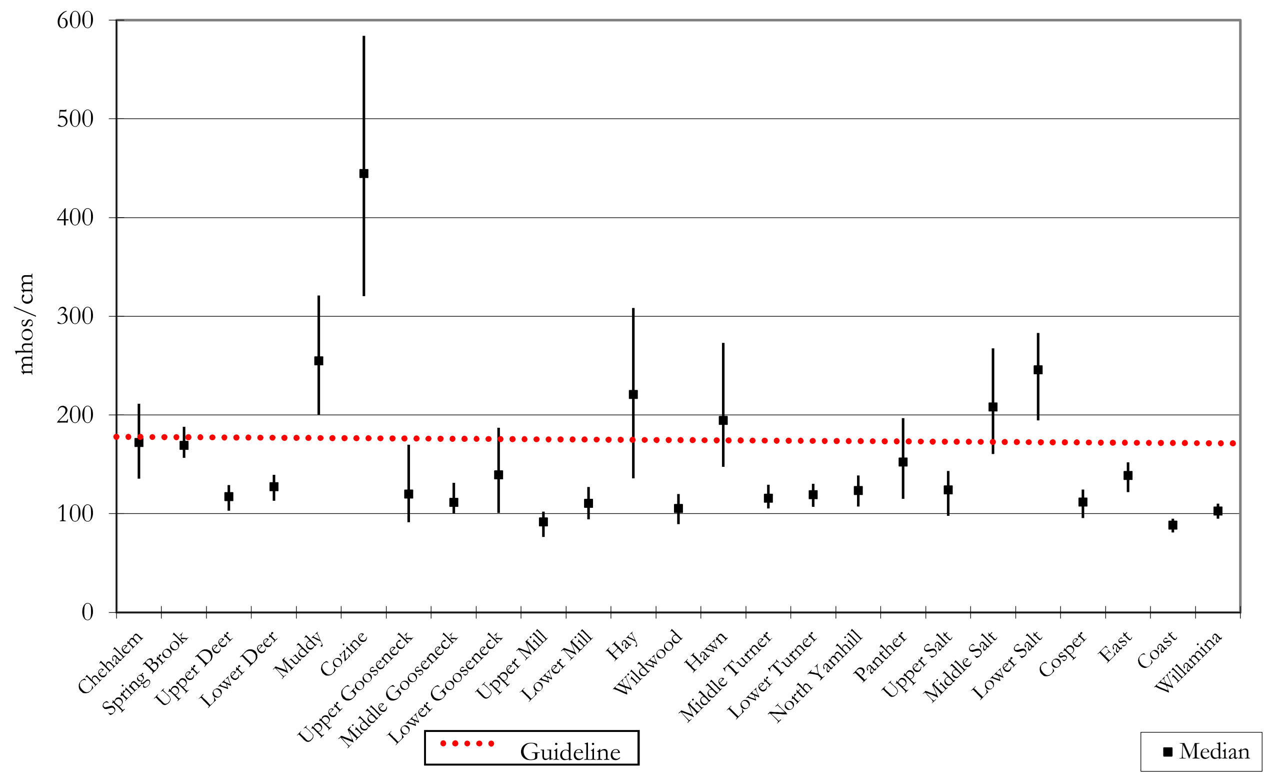


Figure 5.24 Conductivity 2004 Min-Max Results

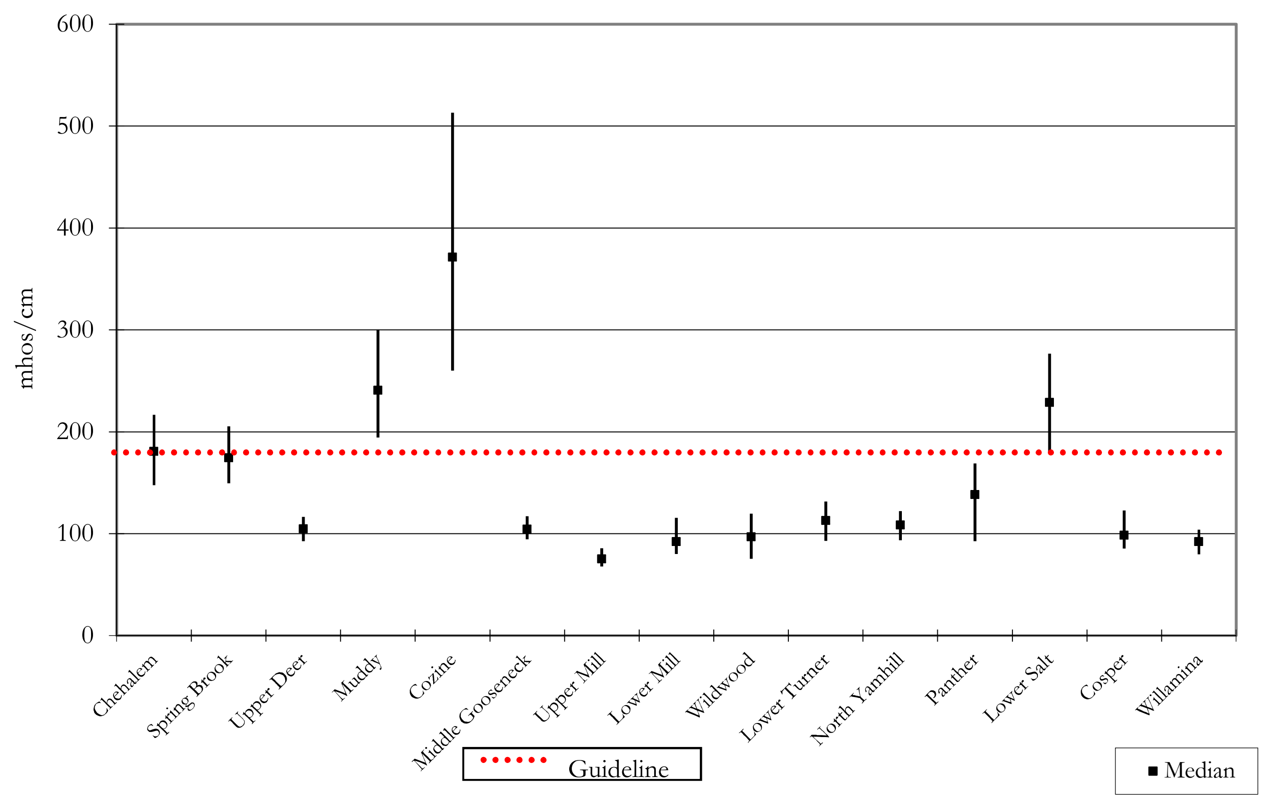


Figure 5.25 *E. coli* 2003 Min-Max Results

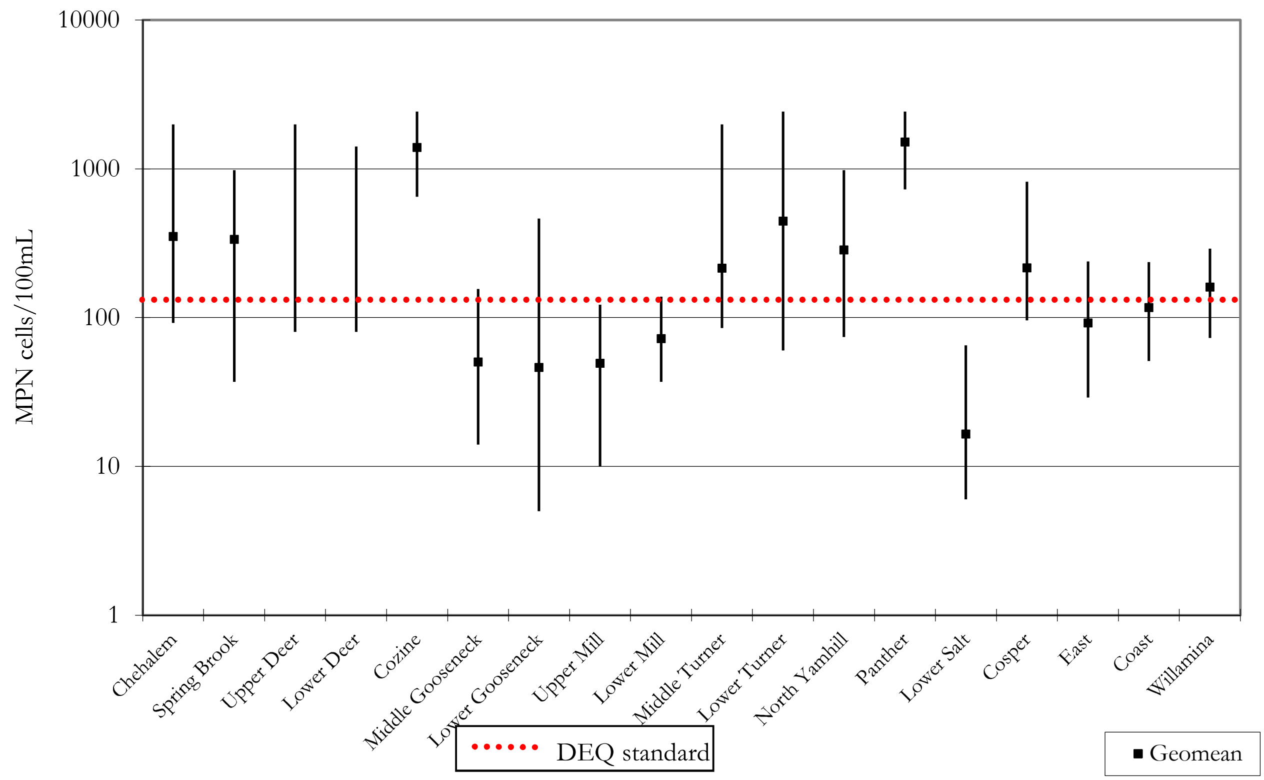
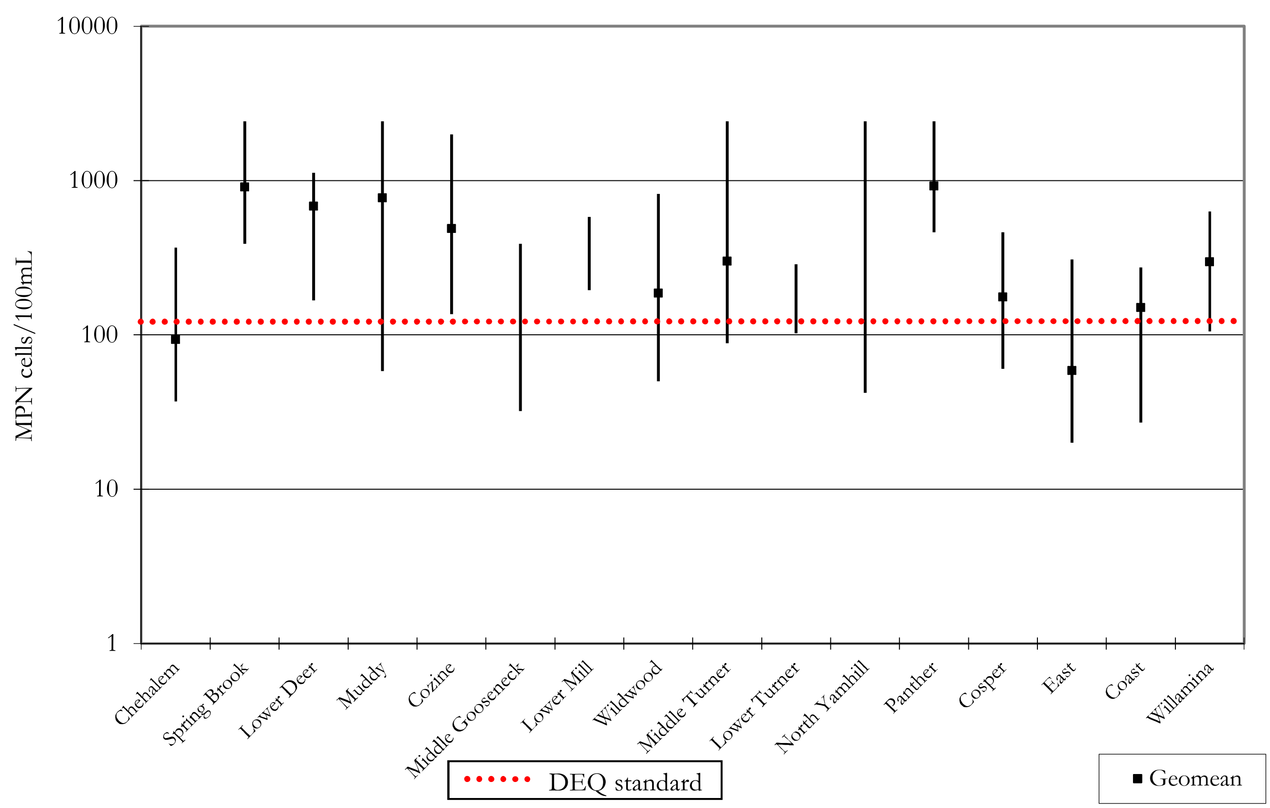


Figure 5.26 *E. coli* 2004 Min-Max Results

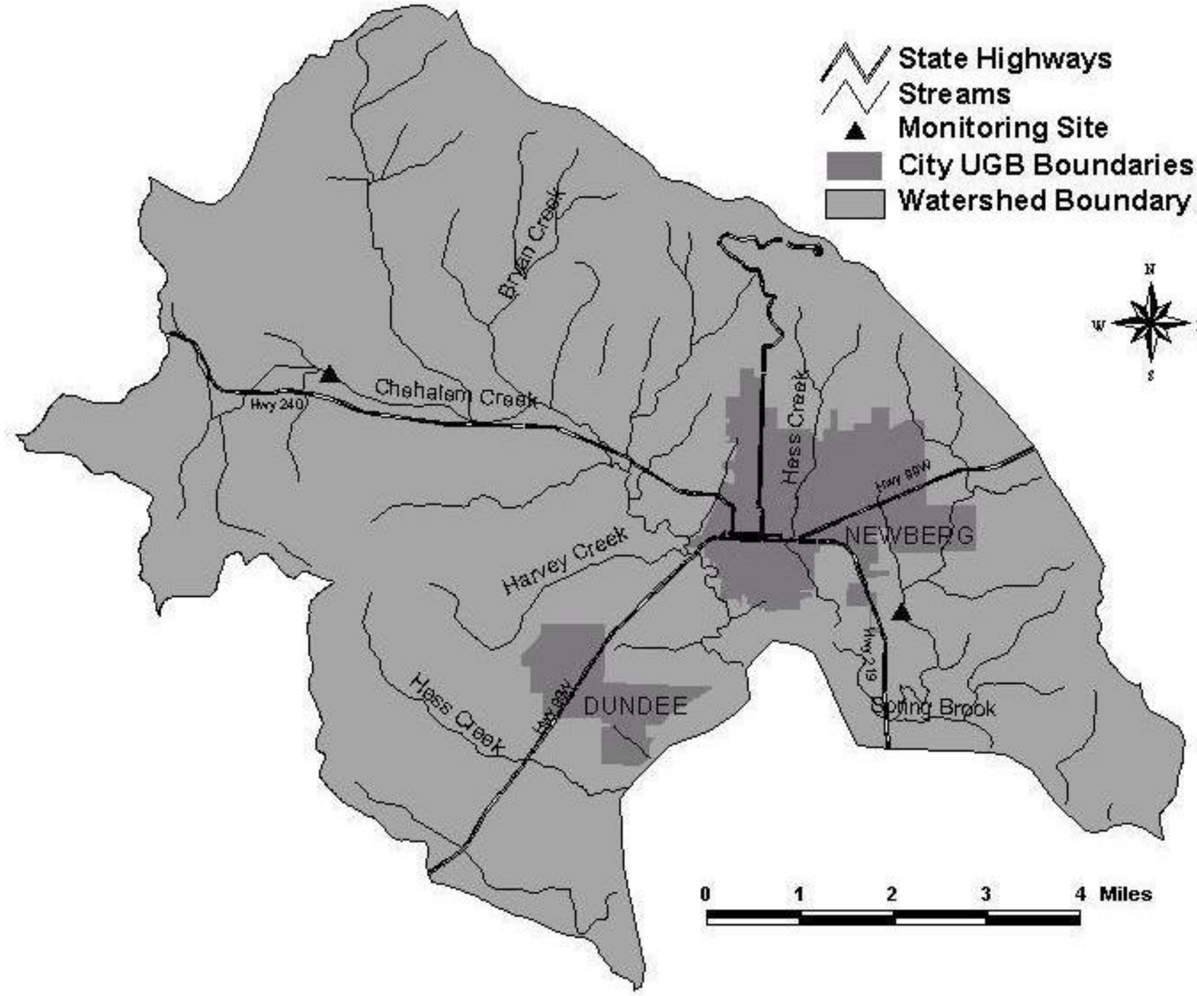


The subwatershed summaries include the following information:

- Map of the subwatershed
- Year that YBC continuous temperature monitoring began in the subwatershed
- Page for each monitoring site, with a photo and the following information, if collected at the site:
  1. Highest 7-day average daily maximum water temperature and date
  2. Seasonal maximum temperature and date
  3. Highest daily change in temperature[31] and date
  4. Number of days above 64ºF
  5. Number of hours above 64ºF
  6. If sites in the watershed met or did not meet dissolved oxygen, turbidity, pH, conductivity and *E. coli* standards and guidelines
  7. Level of impairment of the benthic macroinvertebrate community, based on B-IBI calculated from the samples. B-IBI values < 20 = severe impairment, 20-30 = moderate impairment, 30-40 = slight impairment, > 40 = no impairment
  8. Average gradient, rounded to the nearest 0.5%
  9. Percent average relative canopy cover, rounded to the nearest 5%
  10. Average wetted width, rounded to the nearest five feet

[31] Maximum temperature – minimum temperature

Chehalem Creek Subwatershed Summary



The YBC began stream temperature monitoring in the Chehalem Creek watershed in 2000. Chehalem Creek and Spring Brook independently flow into the Willamette River.

<u>Chehalem Creek</u>

Elevation	75 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/20/03	76.1 F	7/25/04	77.9 F
Seasonal maximum temperature	7/22/03	79.0 F	7/24/04	81.3 F
Seasonal maximum daily change in temperature	7/9/03	12.4 F	6/17/04	12.6 F
Number of days above 64 degrees Fahrenheit		74 days		99 days
Number of hours above 64 degrees Fahrenheit		1551.0 hours		1881.0 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Below standard	Below standard
Turbidity, NTU	Above guideline	Above guideline
pH	Met standard	Met standard
Conductivity, mhos/cm	Above guideline	Above guideline
E. coli, MPN/100 mL	Above one standard, met one standard	Met both standards

Observations:
Reed canary grass, nightshade and Himalayan blackberry are present. Algae growth. Small fish (<8") observed. No large woody debris observed.

Spring Brook

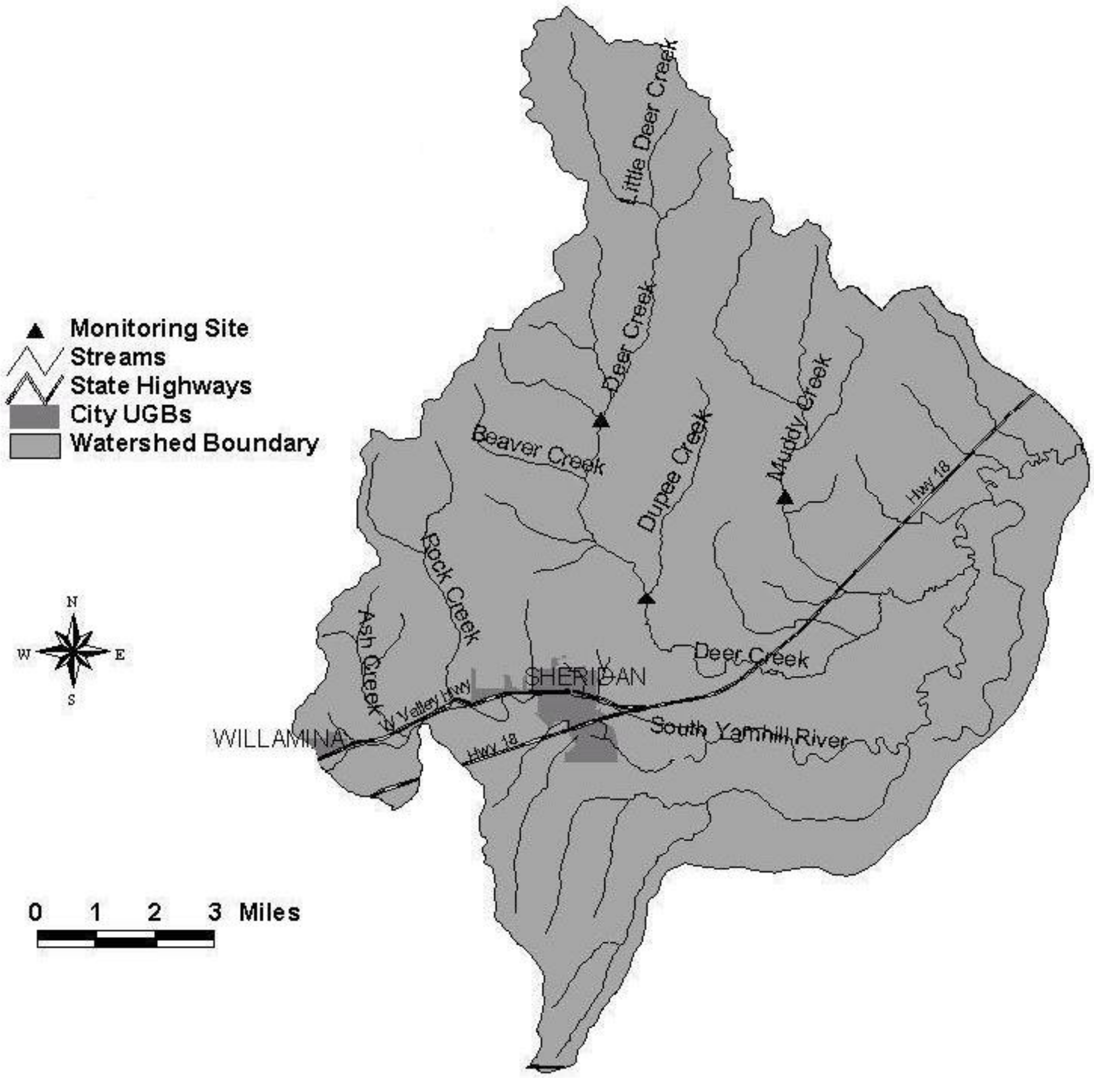
Elevation	112 ft

	Date	Value
Highest 7-day average daily max water temperature	7/21/03	68.9 F
Seasonal maximum temperature	7/22/03	71.4 F
Seasonal maximum daily change in temperature	10/6/03	7.0 F
Number of days above 64 degrees Fahrenheit		55 days
Number of hours above 64 degrees Fahrenheit		658.5 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Below standard	Below standard
Turbidity, NTU	Above guideline	Above guideline
pH	Met standard	Met standard
Conductivity, mhos/cm	Above guideline	Above guideline
E. coli, MPN/100 mL	Above both standards	Above both standards

Observations:
Narrow, channelized stream with a silty bottom. Limited habitat complexity and relatively little canopy cover. Himalayan blackberry present. One crayfish observed.

Lower South Yamhill River Subwatershed Summary



The YBC began stream temperature monitoring in the Lower South Yamhill watershed in 2000. Muddy Creek is a tributary of Deer Creek, which flows into the South Yamhill River.

Upper Deer Creek

Elevation	253 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/30/03	70.5 F	7/26/04	72.5 F
Seasonal maximum temperature	7/21/03	72.3 F	7/24/04	74.5 F
Seasonal maximum daily change in temperature	7/18/03	8.3 F	7/12/04	9.5 F
Number of days above 64 degrees Fahrenheit		70 days		70 days
Number of hours above 64 degrees Fahrenheit		785.5 hours		1060.5 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Met standard	Met standard
Turbidity, NTU	Above guideline	Above guideline
pH	Met standard	Met standard
Conductivity, mhos/cm	Met guideline	Met guideline
E. coli, MPN/100 mL	Above both standards	
Benthic Macroinvertebrates	Slight impairment	
Streambed	50% coarse gravel, 20% fine gravel	
Average Gradient	1.5%	
Average Relative Canopy Cover	90%	
Average Wetted Width	20 feet	

Observations:
Beaver dams upstream and downstream of site during 2004. Small fish (<1”) observed.

Lower Deer Creek

Elevation	194 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/30/03	70.0 F	7/26/04	70.7 F
Seasonal maximum temperature	7/22/03	72.3 F	7/24/04	72.3 F
Seasonal maximum daily change in temperature	7/29/03	5.8 F	7/12/04	5.8 F
Number of days above 64 degrees Fahrenheit		65 days		67 days
Number of hours above 64 degrees Fahrenheit		939.0 hours		1160.5 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Below standard	
Turbidity, NTU	Above guideline	
pH	Met standard	
Conductivity Range, mhos/cm	Met guideline	
E. coli, MPN/100 mL	Above one standard	Above both standards

Observations:
Somewhat silty-bottomed stream. No riffles.

Muddy Creek

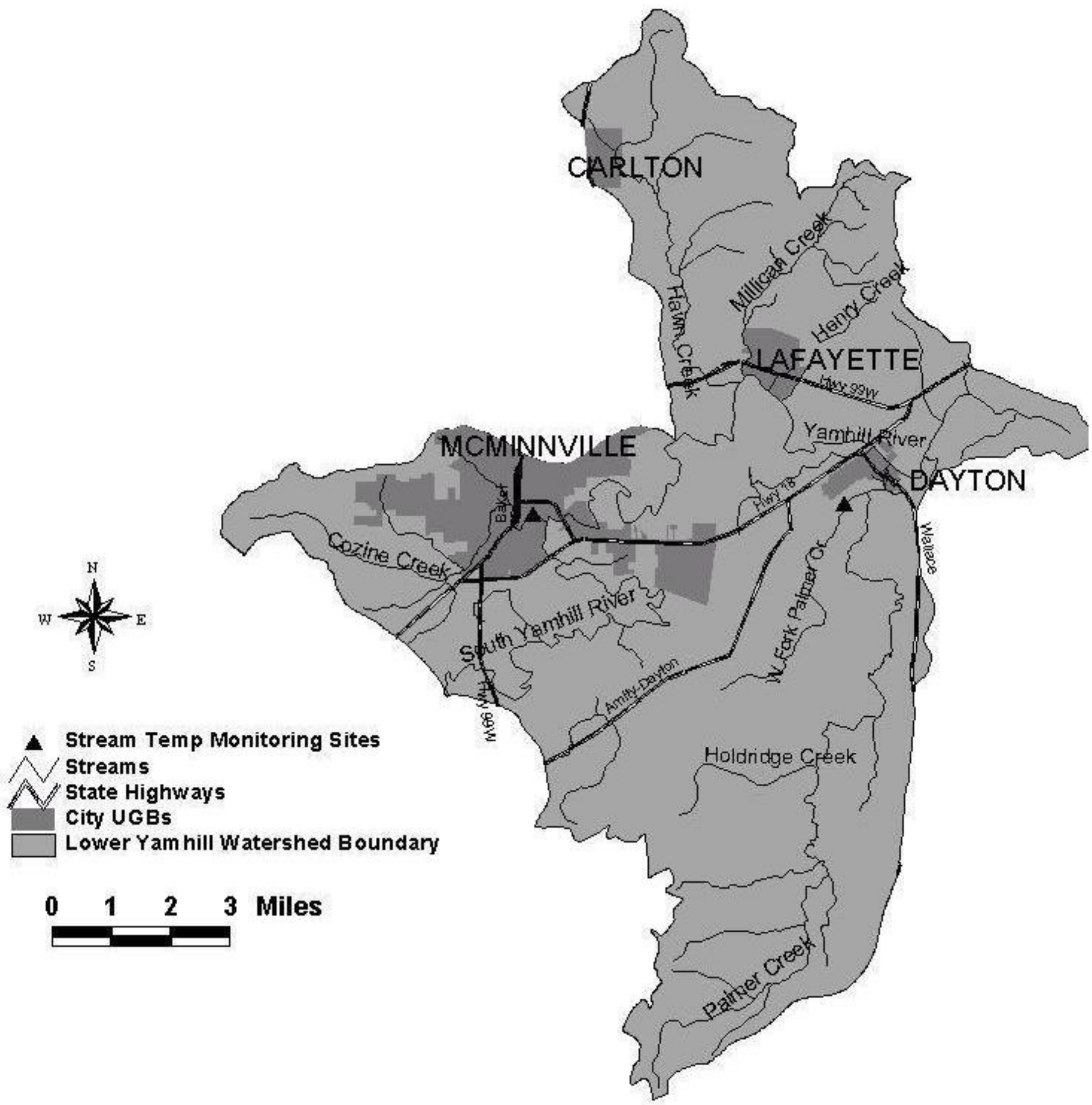
Elevation	177 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/21/03	68.9 F	7/22/04	69.8 F
Seasonal maximum temperature	7/21/03	71.2 F	7/24/04	71.8 F
Seasonal maximum daily change in temperature	6/28/03	8.3 F	5/17/04	7.0 F
Number of days above 64 degrees Fahrenheit		50 days		69 days
Number of hours above 64 degrees Fahrenheit		655.5 hours		1129.5 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Below standard	Below standard
Turbidity, NTU	Above guideline	Above guideline
pH	Met standard	Met standard
Conductivity, mhos/cm	Above guideline	Above guideline

Observations:
Downcut and silty-bottomed stream. Relatively good canopy cover. Some large woody debris present.

Lower Yamhill River Subwatershed Summary



The YBC began stream temperature monitoring in the Lower Yamhill watershed in 2000. Cozine Creek flows through the city of McMinnville and into the South Yamhill River.

Cozine Creek

Elevation	89 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/21/03	70.3 F	7/25/04	71.8 F
Seasonal maximum temperature	7/21/03	71.8 F	7/24/04	73.6 F
Seasonal maximum daily change in temperature	7/27/03	5.8 F	5/17/04	7.0 F
Number of days above 64 degrees Fahrenheit		69 days		85 days
Number of hours above 64 degrees Fahrenheit		1263.0 hours		1711.5 hours

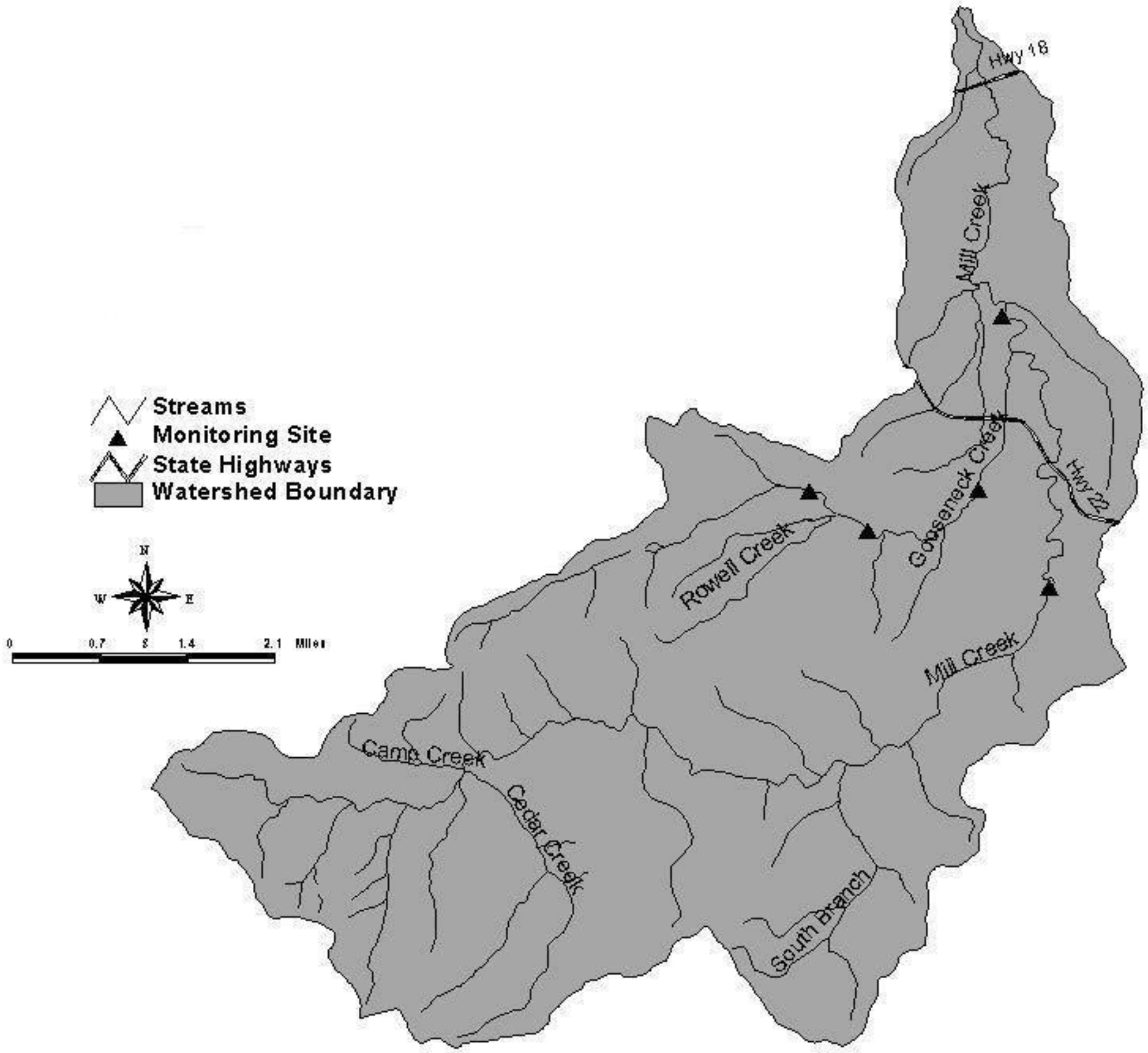
	2003	2004
Dissolved Oxygen, mg O_2/L	Below standard	Below standard
Turbidity, NTU	Above guideline	Above guideline
pH	Met standard	Met standard
Conductivity, mhos/cm	Above guideline	Above guideline
E. coli, MPN/100 mL	Above both standards	Above both standards

Observations:
Silty bottomed-stream. Relatively good canopy cover. No riffles. Possible iron bacteria near seep just upstream of site. Deer observed. Some large woody debris present.

Palmer Creek

			Date	Value
Highest 7-day average daily max water temperature			8/29/04	66.6 F
Seasonal maximum temperature			8/31/04	68.0 F
Seasonal maximum daily change in temperature			6/2/04	6.5 F
Number of days above 64 degrees Fahrenheit				157 days
Number of hours above 64 degrees Fahrenheit				3593.0 hours

Mill Creek Subwatershed Summary



The YBC began stream temperature monitoring in the Mill Creek watershed in 1998. Gooseneck Creek is a tributary of Mill Creek which flows into the South Yamhill River.

Upper Gooseneck Creek

Elevation	604 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	8/1/03	59.9 F	6/19/04	61.3 F
Seasonal maximum temperature	6/29/03	61.2 F	6/18/04	62.4 F
Seasonal maximum daily change in temperature	7/9/03	3.2 F	6/17/04	6.8 F
Number of days above 64 degrees Fahrenheit		0 days		0 days
Number of hours above 64 degrees Fahrenheit		0.5 hours		0.0 hours

	2003
Dissolved Oxygen, mg O_2/L	Below standard
Turbidity, NTU	Above guideline
pH	Met standard
Conductivity, mhos/cm	Met guideline

Middle Gooseneck Creek

Elevation	492 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/29/03	73.9 F	7/26/04	74.3 F
Seasonal maximum temperature	7/22/03	75.6 F	7/24/04	75.6 F
Seasonal maximum daily change in temperature	7/28/03	13.9 F	8/9/04	13.0 F
Number of days above 64 degrees Fahrenheit		75 days		73 days
Number of hours above 64 degrees Fahrenheit		682.0 hours		727 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Below standard	Below standard
Turbidity, NTU	Met guideline	Met guideline
pH	Met standard	Met standard
Conductivity, mhos/cm	Met guideline	Met guideline
E. coli , MPN/100 mL	Met both standards	Met one standard
Benthic Macroinvertebrates	Moderate impairment	Slight impairment
Streambed	30% coarse gravel, 25% cobble	45% cobble, 35% coarse gravel
Average Gradient	1.5%	1%
Average Canopy Cover	80%	85%
Average Wetted Width	10 feet	10 feet

Observations:
Crayfish and fish (<5") observed. Some downcutting on one bank.

Lower Gooseneck Creek

Elevation	407 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	6/30/03	73.0 F	7/15/04	75.0 F
Seasonal maximum temperature	6/28/03	77.2 F	7/12/04	76.1 F
Seasonal maximum daily change in temperature	6/28/03	17.3 F	7/11/04	16.4 F
Number of days above 64 degrees Fahrenheit		54 days		82days
Number of hours above 64 degrees Fahrenheit		812.0 hours		1267.5 hours

	2003 Range
Dissolved Oxygen, mg O_2/L	Below standard
Turbidity, NTU	Met guideline
pH	Met standard
Conductivity, mhos/cm	Above guideline
E. coli, MPN/100 mL	Met one standard

Observations:
Relatively good canopy cover. Great blue heron and small fish (< 1") observed. In September 2003 the site reduced to pools with possible subsurface flow even when upstream site had surface flowing water.

Upper Mill Creek

Elevation	417 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/21/03	71.2 F	7/26/04	73.8 F
Seasonal maximum temperature	7/22/03	73.8 F	7/24/04	75.9 F
Seasonal maximum daily change in temperature	7/27/03	8.1 F	6/16/04	9.0 F
Number of days above 64 degrees Fahrenheit		59 days		67 days
Number of hours above 64 degrees Fahrenheit		625.0 hours		1149.0 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Met standard	Met standard
Turbidity, NTU	Met guideline	Met guideline
pH	Met standard	Met standard
Conductivity, mhos/cm	Met guideline	Met guideline
E. coli, MPN/100 mL	Met one standard	Met one standard
Benthic Macroinvertebrates	Slight impairment	
Streambed	40% cobble, 25% bedrock	
Average Gradient	1%	
Average Relative Canopy Cover	75%	
Average Wetted Width	45 feet	

Observations:
Kingfisher and small fish (<5”) observed.

Lower Mill Creek

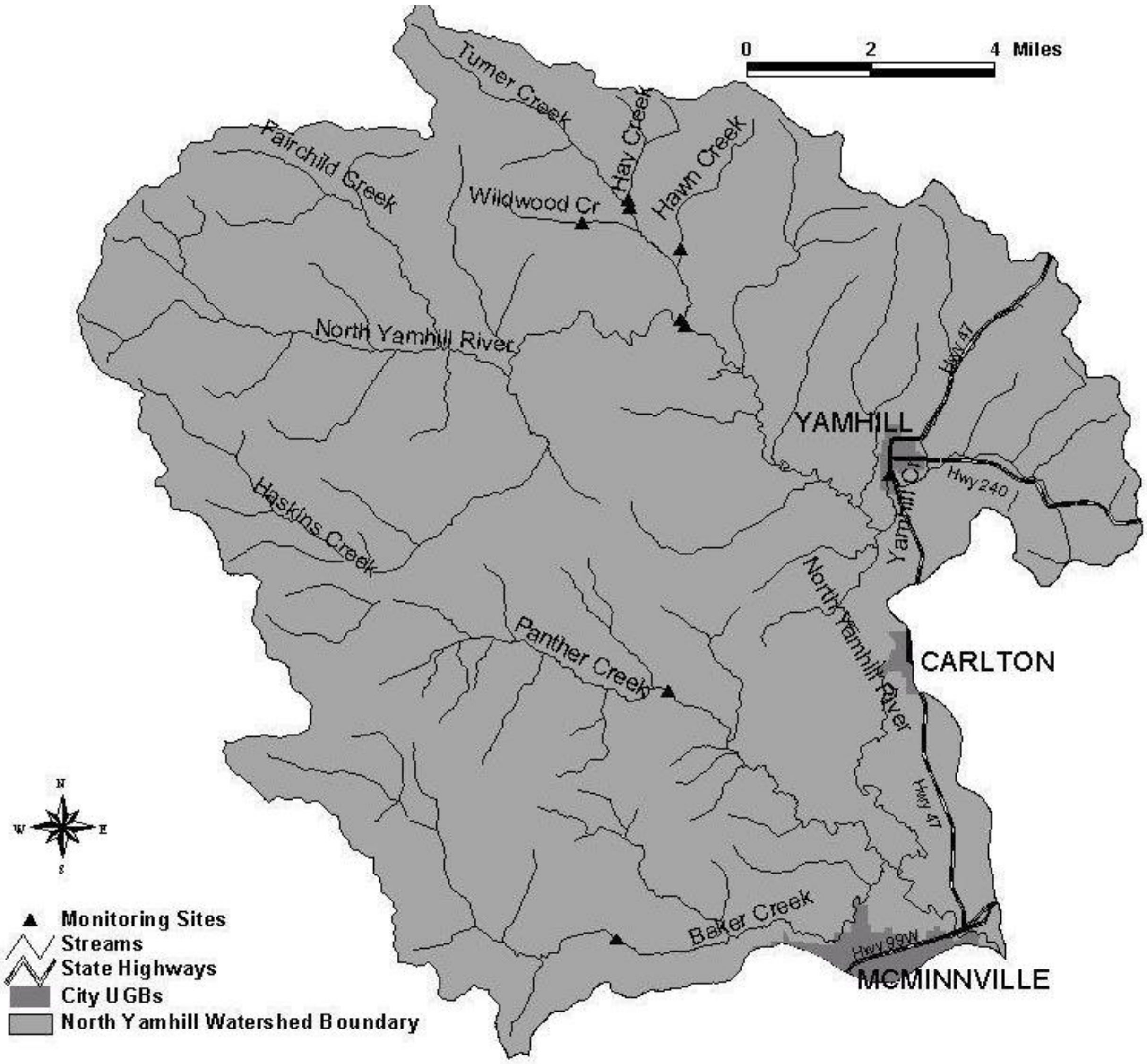
Elevation	236 ft

	Date	Value
Highest 7-day average daily max water temperature	7/20/03	80.4 F
Seasonal maximum temperature	7/21/03	83.7 F
Seasonal maximum daily change in temperature	8/14/03	16.4 F
Number of days above 64 degrees Fahrenheit		97 days
Number of hours above 64 degrees Fahrenheit		1758.5 hours

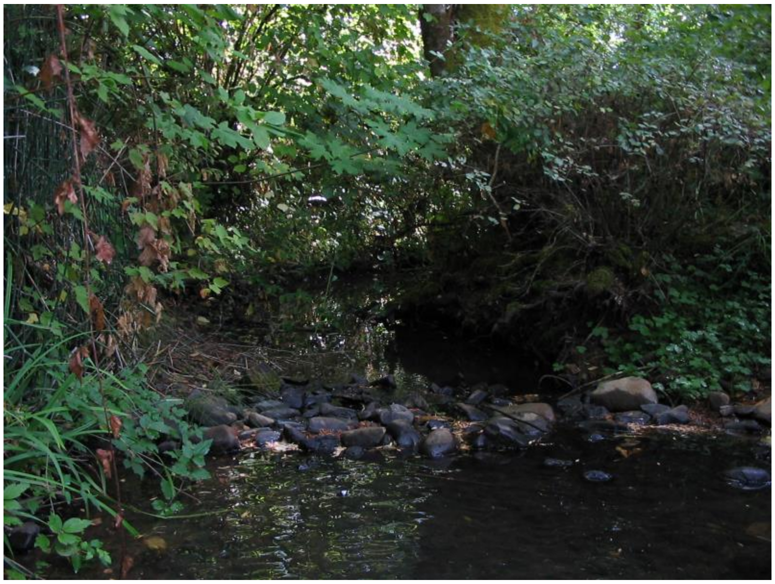
	2003 Range	2004 Range
Dissolved Oxygen, mg O_2/L	Met standard	Met standard
Turbidity, NTU	Met guideline	Met guideline
pH	Met standard	Met standard
Conductivity, mhos/cm	Met guideline	Met guideline
E. coli MPN/100 mL	Met both standards	
Benthic Macroinvertebrates	Moderate impairment	Slight impairment
Streambed	30% bedrock, 30% coarse gravel	30% bedrock, 30% cobble
Average Gradient	1%	1%
Average Relative Canopy Cover	60%	75%
Average Wetted Width	35 feet	30 feet

Observations:
Small fish (<2") observed. Algae observed. Some downcutting. Some large woody debris present.

North Yamhill River Subwatershed Summary



The YBC began stream temperature monitoring in the North Yamhill watershed in 1998. Hay Creek, Wildwood Creek and Hawn Creeks are tributaries of Turner Creek. Turner Creek and Panther Creek flow into the North Yamhill River.



Hay Creek

Elevation	338 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/30/03	64.6 F	8/12/04	66.7 F
Seasonal maximum temperature	7/21/03	66.6 F	7/24/04	69.1 F
Seasonal maximum daily change in temperature	7/28/03	6.5 F	7/22/04	6.8 F
Number of days above 64 degrees Fahrenheit		9 days		36 days
Number of hours above 64 degrees Fahrenheit		71.0 hours		329.0 hours

	2003
Dissolved Oxygen, mg O_2/L	Below standard
Turbidity, NTU	Above guideline
pH	Met standard
Conductivity, mhos/cm	Above guideline
Benthic Macroinvertebrates	Slight impairment
Streambed	45% cobble, 25% sand
Average Gradient	1.5%
Average Relative Canopy Cover	90%
Average Wetted Width	5 feet

Wildwood Creek

Elevation	390 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/30/03	64.0 F	8/12/04	66.2 F
Seasonal maximum temperature	7/30/03	66.4 F	7/24/04	68.5 F
Seasonal maximum daily change in temperature	8/20/03	7.0 F	7/26/04	6.8 F
Number of days above 64 degrees Fahrenheit		7 days		22 days
Number of hours above 64 degrees Fahrenheit		51.5 hours		215.0 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Met standard	Met standard
Turbidity, NTU	Above guideline	Above guideline
pH	Met standard	Met standard
Conductivity, mhos/cm	Met guideline	Met guideline
Benthic Macroinvertebrates	Slight impairment	
Streambed	30% coarse gravel and 30% cobble	
Average Gradient	2.5%	
Average Relative Canopy Cover	95%	
Average Wetted Width	5 feet	

Hawn Creek

Elevation	266 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/1/03	66.7 F	7/23/04	69.1 F
Seasonal maximum temperature	6/28/03	68.5 F	7/24/04	69.4 F
Seasonal maximum daily change in temperature	8/7/03	11.9 F	5/13/04	8.5 F
Number of days above 64 degrees Fahrenheit		23 days		69 days
Number of hours above 64 degrees Fahrenheit		175.0		1419.5 hours

	2003
Dissolved Oxygen, mg O_2/L	Below standard
Turbidity, NTU	Above guideline
pH	Met standard
Conductivity, mhos/cm	Above guideline

Observations:
Silt-bottomed stream. 2003 data collected below relatively well-established beaver dams. Logger was removed early because surface water was absent in August. 2004 data collected above the beaver dams.

Middle Turner Creek

Elevation	322 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/29/03	69.4 F	7/26/04	70.5 F
Seasonal maximum temperature	7/30/03	71.8 F	7/24/04	72.9 F
Seasonal maximum daily change in temperature	6/28/03	10.8 F	7/12/04	10.4 F
Number of days above 64 degrees Fahrenheit		58 days		57 days
Number of hours above 64 degrees Fahrenheit		534.0 hours		687.5 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Met standard	
Turbidity, NTU	Met guideline	
pH	Met standard	
Conductivity, mhos/cm	Met guideline	
E. coli Range, MPN/100 mL	Above both standards	Above one standard
Benthic Macroinvertebrates	Slight impairment	
Streambed	30% sand and 25% coarse gravel	
Average Gradient	1.5%	
Average Relative Canopy Cover	85%	
Average Wetted Width	15 feet	

Observations:
Some large woody debris present.

Lower Turner Creek

Elevation	200 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/30/03	72.3 F	7/26/04	72.7 F
Seasonal maximum temperature	7/30/03	75.2 F	7/24/04	75.6 F
Seasonal maximum daily change in temperature	8/20/03	10.3 F	8/18/04	9.2 F
Number of days above 64 degrees Fahrenheit		73 days		69 days
Number of hours above 64 degrees Fahrenheit		1009.0 hours		1196.0 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Met standard	Below standard
Turbidity, NTU	Above guideline	Above guideline
pH	Met standard	Met standard
Conductivity, mhos/cm	Met guideline	Met guideline
E. coli, MPN/100 mL	Above one standard	Above one standard
Benthic Macroinvertebrates	Moderate impairment	
Streambed	30% coarse gravel and 25% bedrock	
Average Gradient	1%	
Average Relative Canopy Cover	75%	
Average Wetted Width	20 feet	

Observations:
Algae growth. Crayfish and small fish (< 3") observed. Some large woody debris present.

North Yamhill River

Elevation	200 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/29/03	73.2 F	7/26/04	74.1 F
Seasonal maximum temperature	7/30/03	76.1 F	7/24/04	76.5 F
Seasonal maximum daily change in temperature	7/28/03	10.3 F	7/12/04	10.3 F
Number of days above 64 degrees Fahrenheit		74 days		74 days
Number of hours above 64 degrees Fahrenheit		1071.5 hours		1185.0 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Met standard	Met standard
Turbidity, NTU	Met guideline	Met guideline
pH	Met standard	Met standard
Conductivity, mhos/cm	Met guideline	Met guideline
E. coli, MPN/100 mL	Above both standards	Above one standard
Benthic Macroinvertebrates	Slight impairment	
Streambed	35% bedrock, 25% coarse gravel	
Average Gradient	0.5%	
Average Relative Canopy Cover	75%	
Average Wetted Width	50 feet	

Observations:
Mussel shell found.

Panther Creek

Elevation	190 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/20/03	70.2 F	8/13/04	71.1 F
Seasonal maximum temperature	7/22/03	72.3 F	7/24/04	73.2 F
Seasonal maximum daily change in temperature	6/28/03	9.9 F	9/8/04	12.1 F
Number of days above 64 degrees Fahrenheit		67 days		75 days
Number of hours above 64 degrees Fahrenheit		860.5 hours		1101.0 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Met standard	Below standard
Turbidity, NTU	Above guideline	Above guideline
pH	Met standard	Met standard
Conductivity, mhos/cm	Above guideline	Met guideline
E. coli, MPN/100 mL	Above both standards	Above both standards
Benthic Macroinvertebrates		Moderate impairment
Streambed		25% coarse gravel, 20% silt/clay/muck
Average Gradient		1%
Average Relative Canopy Cover		90%
Average Wetted Width		20 feet

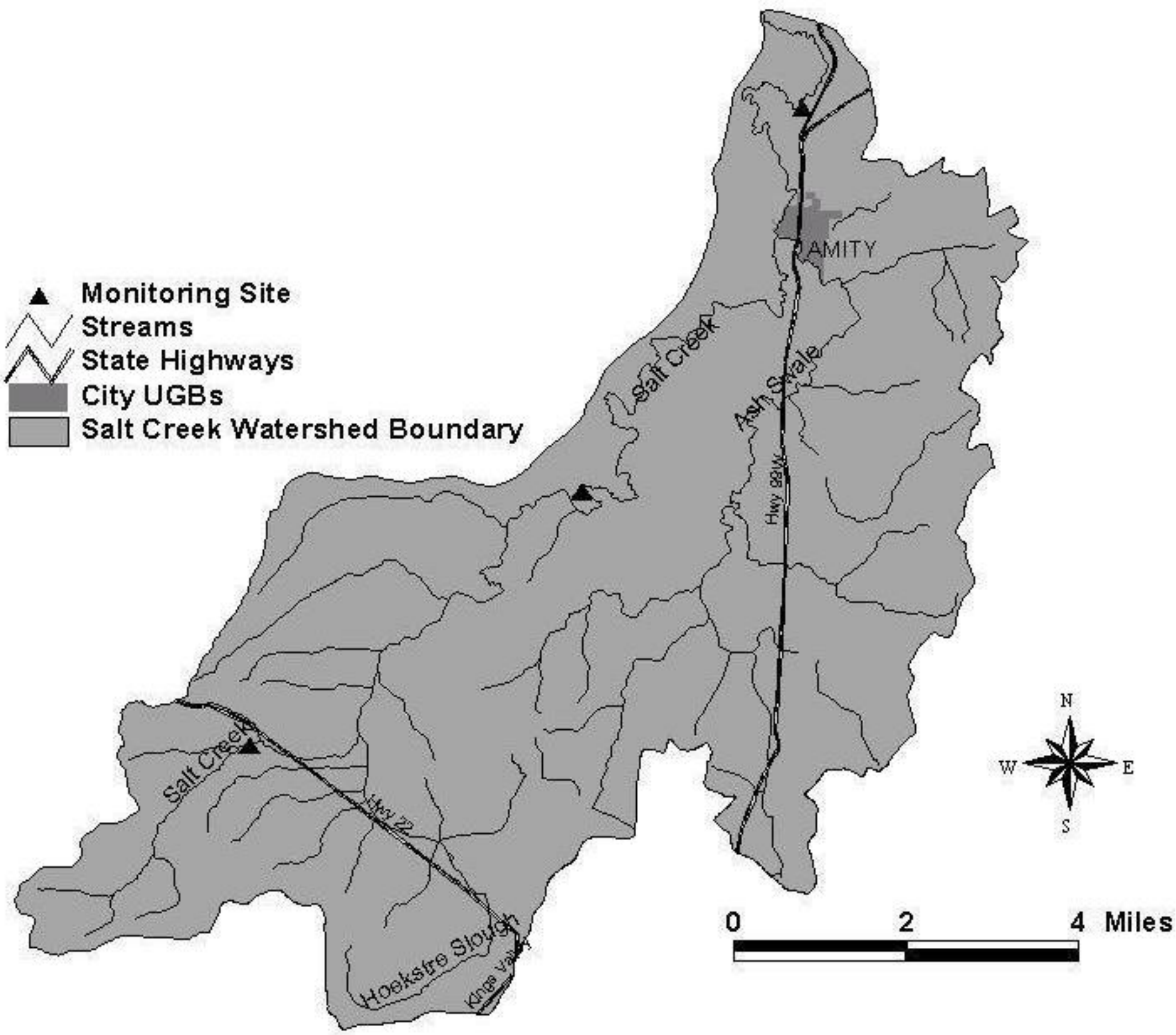
Observations:
Crayfish observed. Reed canary grass present. Some large woody debris present.

Baker Creek

	2003	2004
Benthic Macroinvertebrates		Slight impairment
Streambed		35% coarse gravel, 25% cobble
Average Gradient		1%
Average Relative Canopy Cover		80%
Average Wetted Width		30 feet

Observations:
Some rip rap present. Public park on both banks.

Salt Creek Subwatershed Summary



The YBC began stream temperature monitoring in the Salt Creek watershed in 2000. Salt Creek flows into the South Yamhill River.

Upper Salt Creek

Elevation	292 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/30/03	67.6 F	7/25/04	69.3 F
Seasonal maximum temperature	7/22/03	69.4 F	7/24/04	71.4 F
Seasonal maximum daily change in temperature	7/29/03	7.2 F	6/16/04	8.6 F
Number of days above 64 degrees Fahrenheit		37 days		54 days
Number of hours above 64 degrees Fahrenheit		317.5 hours		631.5 hours

	2003
Dissolved Oxygen, mg O_2/L	Met standard
Turbidity, NTU	Met guideline
pH	Met standard
Conductivity, mhos/cm	Met guideline

Observations:
Relatively good canopy cover. Narrow stream with exposed bedrock. Himalayan blackberry present.

Middle Salt Creek

Elevation	164 ft

No continuous temperature data is available because the data logger was lost in 2003

	2003
Dissolved Oxygen, mg O_2/L	Below standard
Turbidity, NTU	Above guideline
pH	Met standard
Conductivity, mhos/cm	Above guideline

Observations:
Limited canopy cover, although young trees have been planted. Downcut, silty-bottomed stream. No riffles. Reed canary grass present. Kingfisher observed. Impoundments located on this creek. No large woody debris observed.

Lower Salt Creek

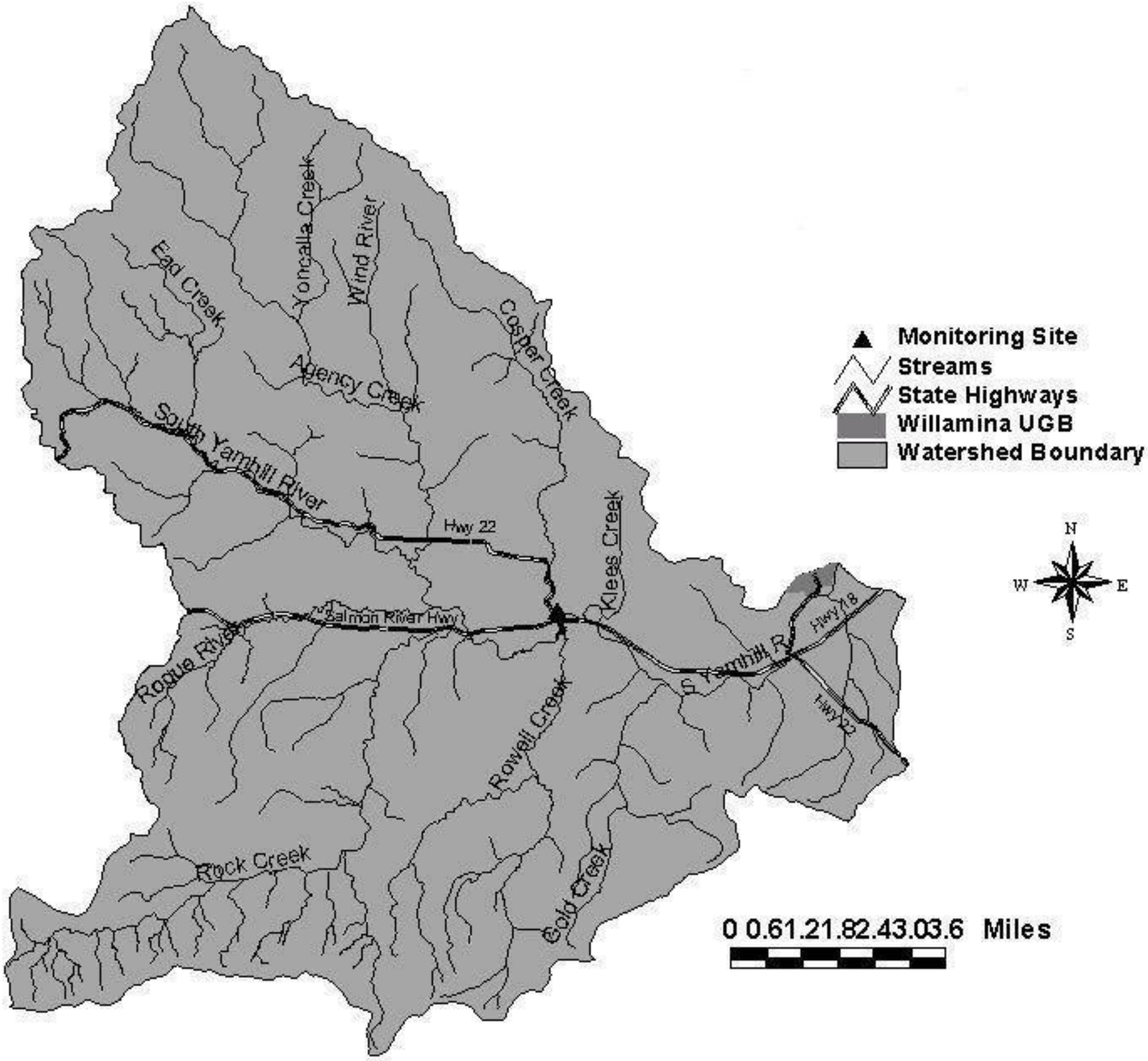
Elevation	112 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/21/03	66.0 F	6/20/04	69.4 F
Seasonal maximum temperature	7/22/03	66.6 F	6/18/04	70.5 F
Seasonal maximum daily change in temperature	7/2/03	2.7 F	6/16/04	4.7 F
Number of days above 64 degrees Fahrenheit		32 days		65 days
Number of hours above 64 degrees Fahrenheit		604.5 hours		1276.5 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Below standard	Below standard
Turbidity, NTU	Above guideline	Above guideline
pH	Met standard	Met standard
Conductivity, mhos/cm	Above guideline	Above guideline
E. coli, MPN/100 mL	Met both standards	

Observations:
Relatively good canopy cover. Silty-bottomed stream. Duckweed present approximately July-September. Water level significantly lower in 2004 than 2003. Small frogs observed. Some large woody debris present.

Upper South Yamhill River Subwatershed Summary



The YBC began stream temperature monitoring in the Upper South Yamhill watershed in 1998. Cosper Creek flows into the South Yamhill River.

Cosper Creek

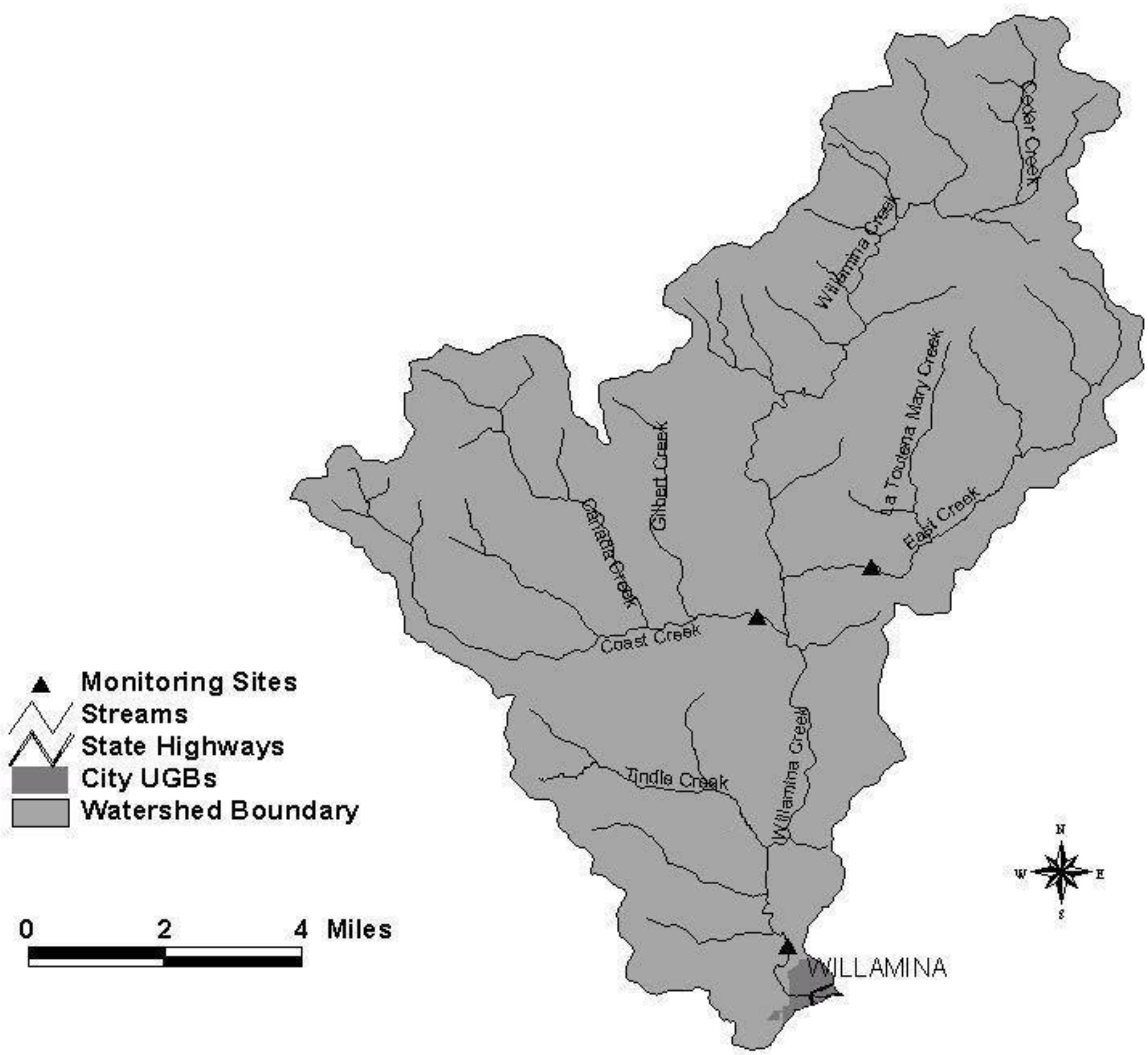
Elevation	282 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/20/03	66.7 F	7/26/04	68.7 F
Seasonal maximum temperature	7/21/03	66.9 F	7/24/04	70.5 F
Seasonal maximum daily change in temperature	6/28/03	9 F	6/12/04	17.1 F
Number of days above 64 degrees Fahrenheit		39 days		57 days
Number of hours above 64 degrees Fahrenheit		281.0 hours		498.5 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Met standard	Met standard
Turbidity, NTU	Above guideline	Above guideline
pH	Met standard	Met standard
Conductivity, mhos/cm	Met guideline	Met guideline
E. coli, MPN/100 mL	Above both standards	Above both standards
Benthic Macroinvertebrates	Slight impairment	
Streambed	30% cobble, 20% bedrock	
Average Gradient	1.5%	
Average Relative Canopy Cover	95%	
Average Wetted Width	15 feet	

Observations:
Crayfish, small fish (<2”) and frog observed.

Willamina Creek Subwatershed Summary



The YBC began stream temperature monitoring in the Willamina watershed in 1999.
Coast Creek and East Creek are tributaries of Willamina Creek, which flows into the South Yamhill River.

East Creek

Elevation	410 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/20/03	67.3 F	7/25/04	68.0 F
Seasonal maximum temperature	7/21/03	69.4 F	7/24/04	69.8 F
Seasonal maximum daily change in temperature	7/27/03	7.9 F	8/8/04	7.7 F
Number of days above 64 degrees Fahrenheit		107 days		45 days
Number of hours above 64 degrees Fahrenheit		2316.0 hours		435.0 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Met standard	
Turbidity, NTU	Met guideline	
pH	Met standard	
Conductivity, mhos/cm	Met guideline	
E. coli, MPN/100 mL	Met both standards	Met both standards
Benthic Macroinvertebrates	Slight impairment	
Streambed	40% cobble, 15% sand	
Average Gradient	1.5%	
Average Relative Canopy Cover	90%	
Average Wetted Width	20 feet	

Observations:
Crayfish, mussel shell and small fish (<3") observed. No large woody debris observed.

Coast Creek

Elevation	374 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/30/03	64.9 F	7/25/04	67.8 F
Seasonal maximum temperature	7/22/03	66.9 F	7/23/04	67.8 F
Seasonal maximum daily change in temperature	6/28/03	9.0 F	6/16/04	9.7 F
Number of days above 64 degrees Fahrenheit		113 days		33 days
Number of hours above 64 degrees Fahrenheit		2600.5 hours		299.0 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Met standard	
Turbidity, NTU	Met guideline	
pH	Met standard	
Conductivity, mhos/cm	Met guideline	
E. coli, MPN/100 mL	Met both standards	Met one standard
Benthic Macroinvertebrates	Slight impairment	
Streambed	40% cobble, 25% bedrock	
Average Gradient	1%	
Average Relative Canopy Cover	75%	
Average Wetted Width	25 feet	

Observations:
Mussel shells, crayfish and small fish (<2") observed. Some large woody debris observed. Some downcutting observed.

Willamina Creek

Elevation	240 ft

	Date	Value	Date	Value
Highest 7-day average daily max water temperature	7/30/03	73.2 F	7/26/04	73.6 F
Seasonal maximum temperature	7/21/03	75.2 F	7/24/04	75.6 F
Seasonal maximum daily change in temperature	8/14/03	7.6 F	6/17/04	7.9 F
Number of days above 64 degrees Fahrenheit		110 days		75 days
Number of hours above 64 degrees Fahrenheit		2609.0 hours		1315.0 hours

	2003	2004
Dissolved Oxygen, mg O_2/L	Met standard	Met standard
Turbidity, NTU	Met guideline	Above guideline
pH	Met standard	Met standard
Conductivity, mhos/cm	Met guideline	Met guideline
E. coli, MPN/100 mL	Met one standard	Above both standards
Benthic Macroinvertebrates	Slight impairment	
Streambed	30% cobble, 25% bedrock	
Average Gradient	1%	
Average Relative Canopy Cover	45%	
Average Wetted Width	30 feet	

Observations:
Crayfish and small fish observed. Himalayan blackberry present. Relatively few conifers. No observed large woody debris.

Chapter 6 Discussion

The following is a brief discussion of the 2003 and 2004 baseline data collected for the Water Quality Monitoring Project. More thorough discussion and analysis may be possible in the future with more time, research and data collection.

Sites which exceeded the ODEQ temperature standard may be a result of

- Insufficient stream shading
- Changes to stream morphology such as widening and reduced depth
- Reduced stream discharge (decreased flow)
- Point sources of warm water
- Natural conditions

Sites below the ODEQ dissolved oxygen standard may be a result of

- Relatively warm water temperatures
- High biological oxygen demand, with sources including sewage or plant matter entering the stream
- Relatively little mixing of air into the water, such as slow moving water with few riffles

Sites above the guideline for turbidity may be a result of

- Insufficient riparian vegetation to prevent erosion and control sediment

Sites above the guideline for conductivity may be result of

- Urban runoff upstream of the site
- Natural conditions such as geology

Sites which exceeded one or both ODEQ *E. coli* standards may be a result of

- Human or animal fecal contamination that may have resulted from leaking septic systems, wildlife, domesticated animals or livestock.

Sites with impaired benthic macroinvertebrate communities may be a result of

- Habitat disturbance
- Natural conditions

Chapter 7 –Conclusion

The Yamhill Basin Council's monitoring program was very successful in 2003 and 2004 thanks to the work of many hardworking volunteers. The only minor problems were pH meter malfunction, three missing temperature loggers and low flows at some sites.

Already most of the goals of the WQMP have been or are in the process of being accomplished:

- Assess water quality in areas of the basin that currently receive little or no monitoring
- Identify additional water quality studies if necessary
- Provide opportunities to educate and involve landowners, residents, and students in water quality monitoring and analysis
- Share water quality information with stakeholders and decision-makers
- Evaluate water quality issues identified on 303(d) list
- Collect data to be provided to ODEQ or other agencies in the eventual creation of new reference sites in the area that better reflect lowland conditions
- Refine our understanding of water quality in each sub-basin
- Prioritize areas/sub-basins in need of water quality improvement
- Combine macroinvertebrate data with other water quality data to provide supporting rationale for impairment of biologic criteria

Additionally the project has:

- Prompted the council to write a new proposal to conduct further water quality monitoring in 2005-2006, including measuring stream flows and researching riparian reference sites
- Created desire to hold a workshop on benthic macroinvertebrates and other wildlife to educate watershed residents
- Prioritized types of best management practices on private lands
- Assisted the SWCD in identifying high priority areas for implementing projects with landowners
- Supported SB 1010 goals of improving conditions on agricultural lands
- Determined restoration and education projects that should be undertaken by the YBC

This is the only standard met at all sites monitored in 2003 and 2004:

- pH of streams

These standards and guidelines are not being met at all sites monitored in 2003 and 2004:

- Temperature
- Dissolved oxygen

- Conductivity
- Levels of *E. coli*
- Benthic macroinvertebrate communities

Recommendations for future efforts:

- Revisit these sites and collect water quality data
- Continue to deploy temperature loggers in May to collect data as stream temperatures warm up
- Collect baseline water quality data on additional parameters, including nutrients and pesticides
- Collect baseline water quality data at new sites, including upstream and downstream of current sites as well as sites on other creeks
- Measure turbidity and *E. coli* during rain events and high flows
- Measure stream flow during summer low flows
- Encourage more landowners to improve riparian conditions by planting native plants, including conifers.
- Work with more landowners to improve in-stream conditions by adding large woody debris
- Work with the CTGR, BLM and private landowners to coordinate monitoring and share data

Literature Cited

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APPENDIX A Macroinvertebrate Reports

The following reports are the 2003 and 2004 benthic macroinvertebrate reports submitted by Ann Potcher.

APPENDIX B Chemical Data

The following tables contain air temperature, water temperature, dissolved oxygen, pH, turbidity and conductivity data collected once a month in June-October in 2003.

The first set of tables is organized upstream to downstream within each subwatershed, with data presented by parameter. This way, one may look at all data collected at one place at one point[32] in time and how it changes over the summer.

The second set of tables is organized by parameter, with data presented upstream to downstream within each subwatershed. This way, one may look at a single parameter and see how it changes upstream to downstream in the watershed during a particular month or how it changes over the summer.

Please consider the "time factor" when viewing the data. Especially for temperature, dissolved oxygen and pH data. See APPENDIX G for raw data including time of collection.

Omissions and notes:

- No pH values for June or October 2003 because of pH meter malfunctioning.
- No data for Hawn Creek in August 2003 because there was no water at the site. September and October 2003 data were collected upstream of the site where flowing water was present.
- 2004 data for Hawn Creek was collected upstream of the 2003 site.

[32] All parameters were measured on site over a span of about 30 minutes, with the exception of dissolved oxygen which was fixed on site and measured in the lab.

APPENDIX C Habitat Data

The following tables contain 2003 and 2004 habitat data and calculations. This data was collected immediately after benthic macroinvertebrates were sampled. Data was not collected at sites that were not sampled for benthic macroinvertebrates.

Notes:

- Shaded cells contain estimated values and empty cells represent data that was not collected due to safety concerns.

APPENDIX D Dissolved Oxygen Criteria

The following table explains ODEQ criteria for dissolved oxygen.

http://www.deq.state.or.us/wq/wqrules/div41/oar340div41tbl21.pdf

APPENDIX E Quality Assurance and Data Quality

This appendix includes:

- DEQ data quality matrix for grading data
- 2003 Split Sampling Report by Steve Hanson, ODEQ
- Test of Independence for Water Quality Data by Paul Measeles, ODA
- DEQ Continuous Temperature Monitoring Data Quality Sheets (audit sheets)
- Data on 2003 and 2004 data quality, duplicate samples, calibration with primary standards or buffers and accuracy checks with secondary standards or buffers

APPENDIX F Chemical Data Statistics

The following tables contain statistical calculations of air temperature, water temperature, dissolved oxygen, pH, turbidity and conductivity data collected once a month from June to October in 2003 and 2004.

APPENDIX G Raw Data

The following tables include raw data collected between June to October in 2003 and 2004 as well as summary tables of 2003 and 2004 temperature monitoring. Habitat data may be found in APPENDIX D. Chapter 4 Figures 4.1-4.8 show 7 day average temperature results which summarizes that continuous temperature monitoring data. Every temperature reading recorded by temperature loggers was not included in this report due to length, but please contact the YBC if interested.