Clark County Environmental Services - Clean Water Program

Long-Term Index Site Monitoring Summary
2002-2011

A trend analysis of Clark County's watershed health

March 2013

Washougal River
Photo credit: Gary Piazza

Acknowledgments

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Program Overview

Clark County's Department of Environmental Services (DES) provides a service to our citizens to protect our surface and groundwater resources. To best understand the health of Clark County's watersheds, rivers and streams, DES staff collect a variety of data through our Clean Water Program's monitoring activities. This *Long-Term Index Site Summary Report* provides an overview of the data collected from 2002-2011 at ten locations throughout Clark County.

The report provides an analysis of the data collected to identify potential trends in the health of the watersheds, highlighting key factors to be considered for future planning efforts. The report will be utilized by County staff to identify priority areas and projects to improve or protect the rivers, streams and creeks throughout our community. DES utilizes several types of monitoring to guide decision-making related to projects that improve our stream health:

- **LONG-TERM INDEX SITE MONITORING** (permanent stations for annual monitoring - establish long term trends)
- **Wadeable Streams Status Monitoring** (intermittent stations for cyclical monitoring - establish current stream health status)
- **Stream Flow and Rainfall Monitoring** (permanent stations for continuous monitoring - track long-term stream flow and support engineering models)
- **Stormwater Characterization Monitoring** (permanent stations for annual monitoring - characterize stormwater runoff from residential and commercial areas)
- **Stormwater Facility Testing** (short-term stations - test the effectiveness of stormwater facilities at removing pollutants)
- **Illicit Discharge Screening** (single visit monitoring - establish the presence of illicit connections or discharges to the storm sewer system)

  [Additional monitoring information can be found in the Stream Health Report]

Methodology for Long-Term Index Site Monitoring

Clark County Environmental Services maintains a network of ten long-term water quality and benthic macroinvertebrate (aquatic insects) monitoring stations. These stations were selected to provide geographic coverage across the range of wadeable streams within Clark County.

Variables measured:

- Temperature
- Dissolved oxygen
- pH
- Total solids
- Inorganic nitrogen
- Total phosphorus
- Bacteria (fecal coliform)
- Benthic Macroinvertebrates

The water quality index analyzes a defined set of variables and produces a score describing general water quality. The index includes sub-scores for temperature, dissolved oxygen, pH, total solids, inorganic nitrogen, total phosphorus and bacteria. Overall index scores range from 10 (worst case) to 100 (ideal water quality).

For this analysis, water quality index results were calculated for all samples collected from 2002 through 2011. Each station was analyzed for the presence of significantly increasing or decreasing trends in the index, its individual variables, and turbidity (a measure of water clarity). The statistical test used for trend analysis ensures that significant identified trends were not due to normal seasonal variation in water quality. The magnitude and direction of trends are reported at the 80 percent or greater confidence level (there is an 80% chance that the true magnitude of change is close to what was calculated).

The benthic macroinvertebrate (aquatic insects) index produces a biological health score using ten metrics describing the numbers and kinds of macroinvertebrates found in the stream. Macroinvertebrates are insects large enough to be seen with the naked eye and which spend a large part of their life-cycle in streams. Because

they are exposed to in-stream conditions for lengthy time periods during their development, stream insects are an excellent way to measure overall stream health. Index scores range from 10 (worst case) to 50 (ideal biological health). A healthy insect population means that there is a diverse food source for fish and wildlife that depend on the stream.

For this analysis, benthic macroinvertebrate index results were calculated for all samples collected from 2002 through 2011. Each station was analyzed for the presence of significantly increasing or decreasing trends in the index. Trends are reported when the analysis indicates a 95% or greater chance that a perceived trend is real.

Why are these water quality measures important?

- **Water temperature, dissolved oxygen, and pH** affect fish health
- **Sediment** affects water clarity, carries pollutants and smothers fish eggs
- **Nutrients** can increase the number of plants that shade the water and promote algae growth
- **Bacteria** cause health problems and indicate animal waste or leaks from human waste systems

A healthy forest allows a significant amount of rainfall to soak into the ground or evaporate from the plant surface

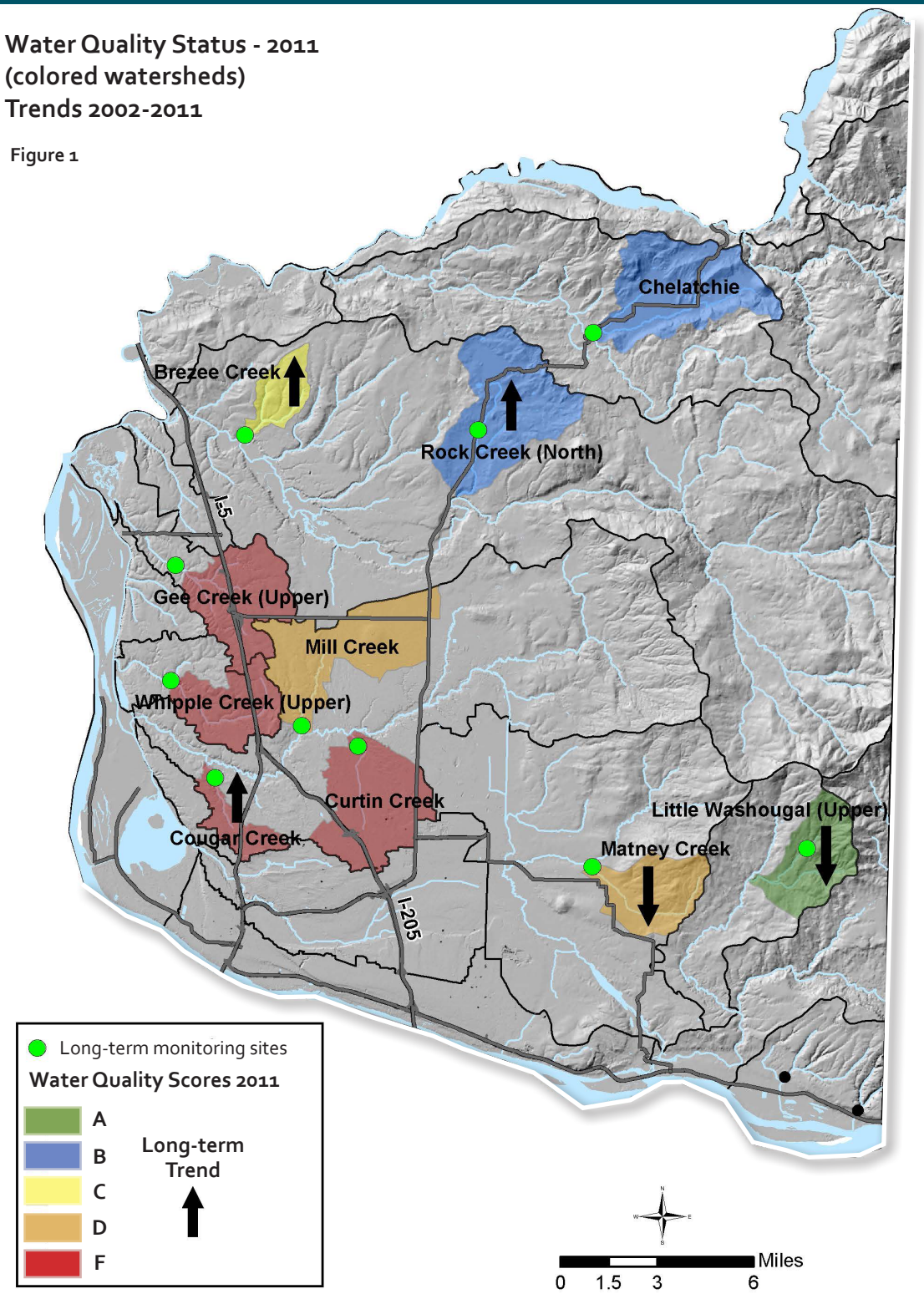
A degraded stream tends to have too much water that causes erosion and destroys valuable habitat.

A healthy stream has rocks & riffles for good insect and fish habitat; good water volumes for oxygen; and, overhanging plants for shade

Long-Term Index Site Results (2002-2011)

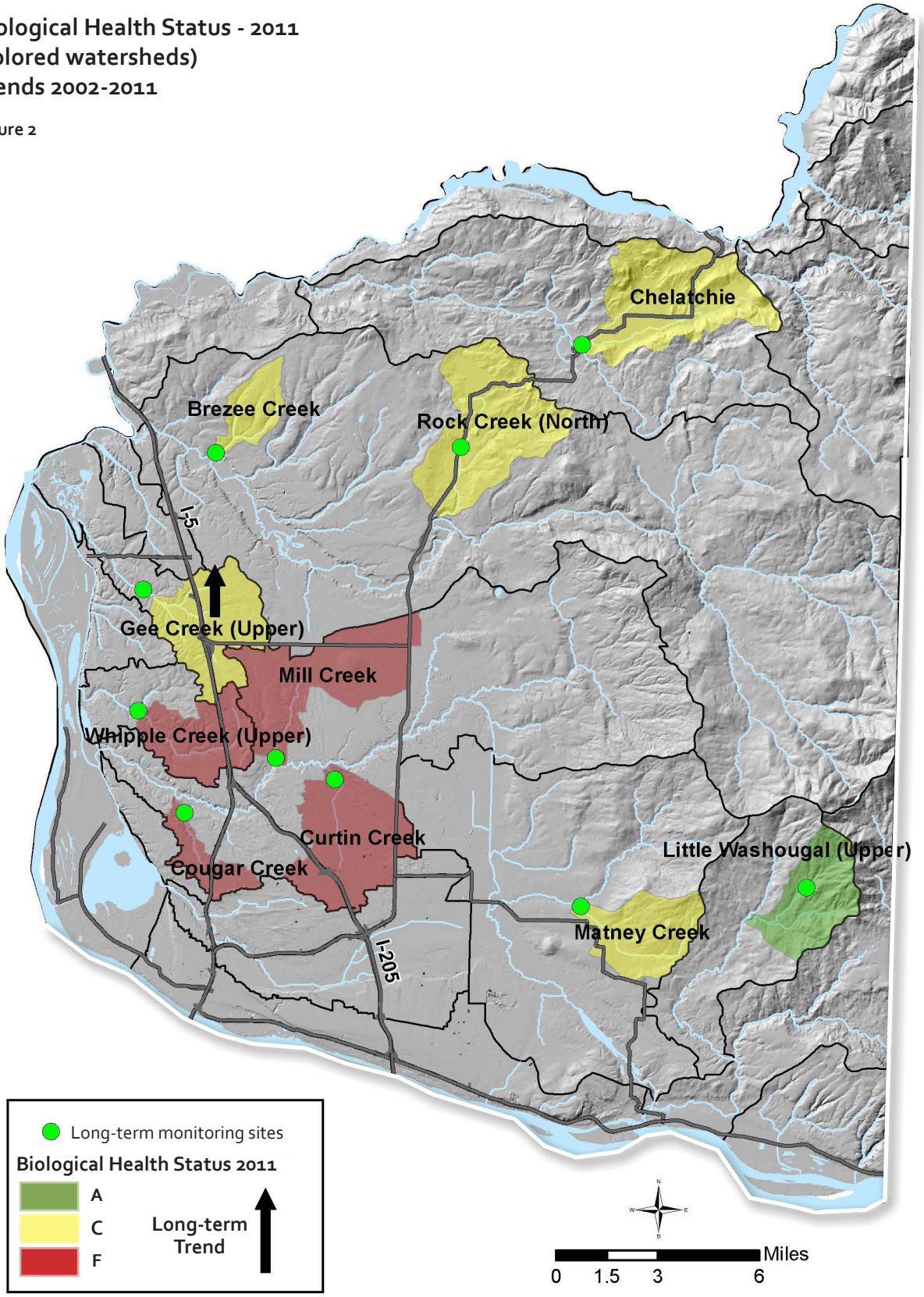
Clark County analyzed water quality (monthly) and benthic macroinvertebrate (annual) data collected from ten wadeable stream stations during 2002 through 2011. This document utilizes procedures and formats used by the Oregon Department of Environmental Quality to describe water quality status and trends.

A water quality index is a score based on a set of measured water quality variables. Similarly, a benthic macroinvertebrate index is a biological health score based on measurements of the kind and number of insects living on the stream bottom. Each station was analyzed for the presence of significant trends in water quality and benthic scores, as well as individual water quality variables. Figures 1 and 2 summarize current status and 10-year trends for water quality and biological health, respectively.


Water Quality Status - 2011
(colored watersheds)
Trends 2002-2011
Figure 1
Chelatchie
Brezee Creek
Rock Creek (North)
I-5
Gee Creek (Upper)
Mill Creek
Whipple Creek (Upper)
Curtin Creek
Cougar Creek
Little Washougal (Upper)
Matney Creek
I-205
Long-term monitoring sites
Water Quality Scores 2011
A
B
C
D
F
Long-term Trend
Miles
0 1.5 3 6

Biological Health Status - 2011
(colored watersheds)
Trends 2002-2011

Figure 2



2011 Water Quality Status and Ten-Year Trends

The current status (2011 condition), trends (improving or declining), and the magnitude of change in the overall water quality index for the ten long-term stations is shown in Table 1.

Monitoring station	Station Code	Direction[3]	Magnitude[1]	Significance[2]	2011 Condition
Brezee Creek upstrm of La Center Bottoms trail bridge	BRZ011	Improving	4.9	95%	Fair
Cougar Creek upstrm of NW 119th St	CGR020	Improving	5.0	95%	Very Poor
Chelatchie Creek upstrm of SR 503	CHL010	None	--	--	Good
Curtin Creek downstrm of NE 139th St	CUR020	(Improving)	--	95%	Very Poor
Gee Creek downstrm of Royle Road	GEE050	None	--	--	Very Poor
Little Washougal River (upper)	JNS060	Declining	-3.4	95%	Excellent
Matney Creek upstrm of NE 68th St	MAT010	Declining	-3.9	95%	Poor
Mill Creek upstrm of Salmon Cr Ave	MIL010	None	--	--	Poor
Rock Creek North upstrm of Gabriel Road	RCN050	Improving	2.5	80%	Good
Whipple Creek upstrm of NW 179th St	WPL050	None	--	--	Very Poor

Notes: 1 - Magnitude of increase or decrease as change in index value during 2002-2011. 2 - Significance level of trend analysis results. 3 - Direction in parentheses indicates some evidence of a statistical trend but no associated slope could be determined.

What is the current water quality condition?

As of 2011, six of the ten long-term stations had Poor or Very Poor water quality based on the index. Three had Good or Excellent water quality, and the remaining station had Fair water quality.

Generally speaking, the stations with the worst water quality are located in urban or urbanizing watersheds. The three stations with the best water quality are located in rural or forested watersheds well outside the urbanized areas of Clark County.

Is water quality improving or declining?

Over the ten-year assessment period, three stations had significant increases in overall water quality, and one additional station showed a statistical change for the better (CUR020) but no measurable improvement. Two stations had significant decreases in overall water quality.

Three of the four sites with statistically increasing index scores were in streams in Very Poor to Fair condition, indicating that the largest water quality improvements occurred at locations with the most room for improvement.

The two stations with declining index scores were in streams at opposite ends of the spectrum: Matney Creek has poor water quality that is further declining, while Jones Creek, located in an entirely forested area, is the only station currently in excellent condition. The remaining five stations showed no significant trend in either direction.

Turbidity is a common indicator of general water quality that measures haziness caused by suspended particles by assessing how light scatters when it passes through the water. This parameter is not part of the water quality index, but is regulated under the State of Washington water quality standards and is a useful tool for describing water quality and trends. Higher turbidity means an increased

amount of particles floating in the water and generally poorer water quality. These floating particulates are typically composed of soil particles, microscopic plants or animals, or other organic substances. From 2002 - 2011, turbidity shows an increasing trend at 8 of the 10 long-term stations at a 95% confidence level, indicating degrading water quality.

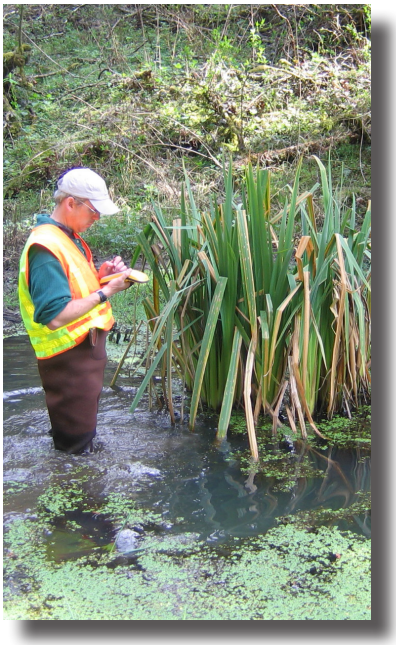
Why is water quality improving or declining?

Among the seven individual variables of the index, two (total solids and fecal coliform bacteria) tended to have more sites showing possible or significant increasing index scores and fewer sites with decreasing trends. The opposite is true for total phosphorus and inorganic nitrogen scores, with more sites tending to have decreasing scores and fewer increasing. The remaining variables had very few statistically observable trends, but both dissolved oxygen and temperature suggested possible increasing scores, while pH data tended to suggest decreasing scores.

While these are general patterns, they support several observations about sources of impairment and why we may be seeing changes:

- ***NPDES permit implementation*** tends to focus on the heavily urbanized areas where water quality is poor; we are tending to see water quality improvement in these areas. Important actions include water quality treatment retrofits, stormwater system maintenance, source-control efforts, public education, and others.

- ***Significant efforts have been made by Clark County and other entities to address fecal coliform bacteria***, including implementation of state Water Cleanup Plans, public outreach to improve management of pet waste, increased septic system inspections and conversion to sewer, agricultural waste management plans and manure management workshops, and others.



- ***Groundwater phosphorus concentrations are naturally high*** in many Clark County watersheds. Scores have decreased over most of the long-term stations, indicating an increase in phosphorus concentrations nearly county-wide over the past ten years. These trends likely reflect climatic patterns that impact stream flow and the influence of groundwater on streams.

- ***Turbidity is increasing (degrading water quality)*** at nearly all the long-term stations, and once again may reflect climatic patterns as well as human influence. Turbidity tends to be highest during wet periods as particulates and soil are washed into streams -- as winters become wetter in the region, this points to continually increasing turbidity. Higher nutrient concentrations in surface water may be contributing to increased algae and organic growth in streams, leading to increased summertime turbidity. Low summer flows in recent years also tend to concentrate algae and particulates, further influencing turbidity values.

2011 Biological Health Status and Ten-Year Trends

The current status (2011 condition), trends (improving or declining), and the magnitude of change in the overall benthic macroinvertebrate index for the ten long-term stations is shown in Table 2

Monitoring station	Station Code	Direction[3]	Magnitude[1]	Significance[2]	2011 Condition
Brezee Creek upstrm of La Center Bottoms trail bridge	BRZ011	(Declining)	6.8	not	Moderate
Cougar Creek upstrm of NW 119th St	CGR020	None	--	--	Low
Chelatchie Creek upstrm of SR 503	CHL010	(Improving)	2.7	not	Moderate
Curtin Creek downstrm of NE 139th St	CUR020	(Improving)	3.3	not	Low
Gee Creek downstrm of Royle Road	GEE050	Improving	10.0	0.01	Moderate
Little Washougal River (upper)	JNS060	None	--	--	High
Matney Creek upstrm of NE 68th St	MAT010	None	--	--	Moderate
Mill Creek upstrm of Salmon Cr Ave	MIL010	(Declining)	2.8	not	Low
Rock Creek North upstrm of Gabriel Road	RCN050	(Improving)	9.0	not	Moderate
Whipple Creek upstrm of NW 179th St	WPL050	None	--	--	Low

Notes: 1 - Magnitude of increase or decrease as change in index value during 2002-2011. 2 - Significance level of trend analysis results. 3 - Direction in parentheses indicates some evidence of a change over time, but the trend is not statistically significant.

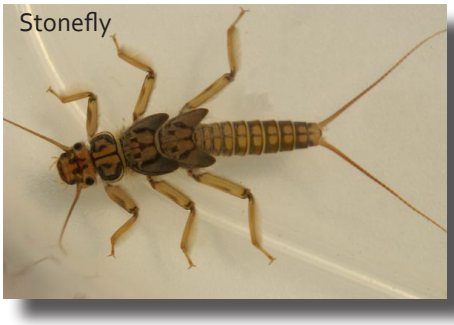
What is the current biological condition?

Benthic macroinvertebrates are used as an indicator of stream health as they require high water quality for sensitive species to survive in the waterbody. The higher the presence of sensitive insect species, the more likely fish and other wildlife will thrive at the location. As of 2011, nine out of ten long-term stations had low or moderate biological health based on the benthic index.

Stations with low to moderate biological health are found throughout Clark County, reflecting impacts from both urban and rural land uses . Only Jones Creek in the forested upper Little Washougal River basin had high biological health in 2011.

Is biological condition improving or declining?

Biological condition has remained about the same over the ten-year assessment period. Although a number of stations show potentially improving (4) or potentially declining (2) biological health, only one station had a statistically significant trend. A manure spill in Gee Creek upstream of the station in the early 2000's decimated the benthic macroinvertebrate community. The increasing trend in biological health at this location likely reflects the process of recovery after the spill.


Stonefly

Mayfly

Caddisfly

Trend Analysis Conclusions

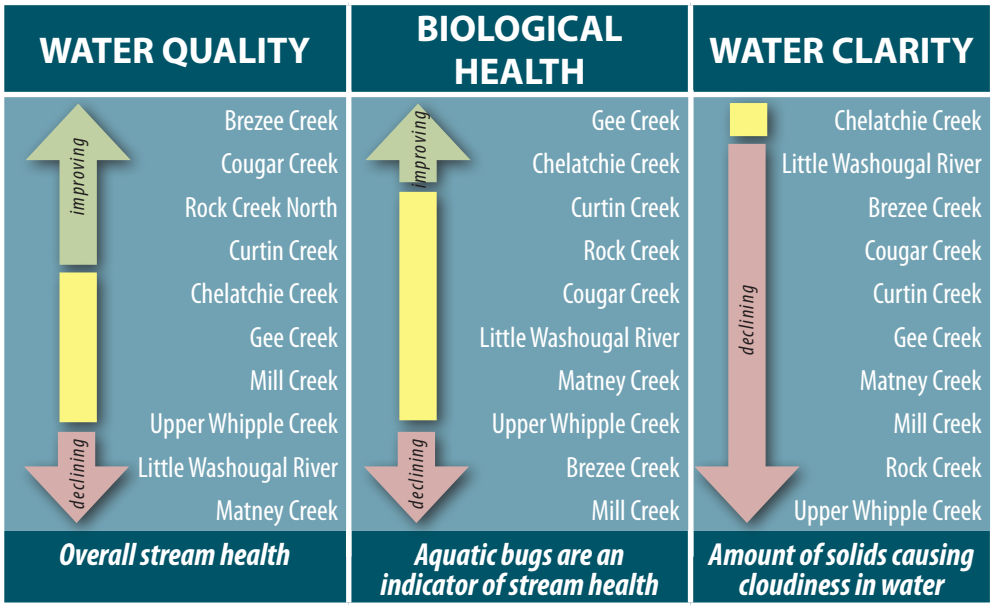
This analysis summarizes current water quality and biological health at ten long-term index stations, and identifies stations where stream health has improved or declined significantly over the past decade. Examined independently or in concert with other County monitoring information, these results can be used to support watershed assessment, stormwater capital and basin planning, and mitigation planning. Together with data from *Wadeable Streams Status Monitoring* and other projects, long-term trend data provide the cornerstone for county-wide assessment of stream health. These datasets further our ability to objectively determine the suitability of streams as salmon habitat, evaluate the need for and success of stormwater management efforts, and evaluate the extent to which overall community actions are protecting stream health in these important index subwatersheds.

This work will also be used in concert with information gathered from other agencies and partners working throughout Clark County to improve and protect our waterways. Many important projects involve multiple partners working towards various goals, such as increasing fish habitat, limiting erosion, increasing tree canopy, limiting pollution sources or adding recreational access. The trends identified in this report, along with information gathered by our partners, can help prioritize projects and potential funding sources to complete key projects.

Future work may include assessment of changes in land use and land cover that could be affecting water quality. There has been significant growth during the assessment period that could be a factor in changes in water quality. The changes to the NPDES stormwater permit in 2013 may have a positive affect on water quality as it continues to move towards use of Low Impact Development techniques that manage stormwater on-site. As more projects are retrofitted by the County and new development implements LID techniques, there could be a positive change in overall stream health.

TRENDS *stream health 2002-2011*

Trends based on 10 years of data.



Appendix A
Index and Individual Variable Scores

	OWQI			Fecal coliform bacteria			Total solids			Total phosphorus		
	Direction [1]	*Slope* [2]	*Signif* [3]	*Direction*	*Slope*	*Signif*	*Direction*	*Slope*	*Signif*	*Direction*	*Slope*	*Signif*
BRZ	improving	0.49	95	*improving*	--	95	--	--	not	*improving*	0.18	not
CGR	improving	0.5	95	improving	0.8	90	improving	0.4	80	declining	-0.5	95
CHL	--	--	not	*declining*	--	95	improving	0.25	80	declining	-0.12	80
CUR	*improving*	--	95	--	--	not	improving	0.5	95	declining	-0.51	95
GEE	--	--	not	improving	0.28	90	--	--	not	*declining*	0.37	not
JNS	declining	-0.34	95	--	--	not	*declining*	--	95	*improving*	--	95
MAT	declining	-0.39	95	--	--	not	--	--	not	*declining*	--	90
MIL	--	--	not	*declining*	--	80	--	--	not	*declining*	0.4	not
RCN	improving	0.25	80	--	--	not	*improving*	0.17	not	--	--	not
WPL	--	--	not	*improving*	0.25	not	--	--	not	*declining*	0.25	not

	Inorganic Nitrogen			Temperature			Dissolved Oxygen			pH		
	Direction	*Slope*	*Signif*	*Direction*	*Slope*	*Signif*	*Direction*	*Slope*	*Signif*	*Direction*	*Slope*	*Signif*
BRZ	--	--	not	--	--	not	*improving*	--	90	--	--	not
CGR	improving	0.27	95	*declining*	--	80	--	--	not	--	--	not
CHL	--	--	not	*improving*	--	95	*improving*	--	95	*declining*	--	95
CUR	*improving*	--	95	*declining*	--	95	improving	0.5	95	*improving*	--	95
GEE	declining	-0.51	95	*improving*	--	95	*improving*	--	90	--	--	not
JNS	declining	-0.33	95	*improving*	--	80	--	--	not	declining	0.25	95
MAT	declining	-0.25	80	*improving*	--	90	*improving*	--	90	*declining*	--	95
MIL	--	--	not	--	--	not	*improving*	--	95	--	--	not
RCN	*improving*	0.33	not	*improving*	--	95	*improving*	--	95	*declining*	--	95
WPL	declining	-1.2	95	*improving*	--	95	*improving*	--	95	*improving*	--	80

	BIBI		
	Direction [4]	*Slope* [5]	*Signif* [6]
BRZ	*declining*	-0.68	not
CGR	--	--	not
CHL	*improving*	0.27	not
CUR	*improving*	0.33	not
GEE	improving	1	alpha = 0.01
JNS	--	--	not
MAT	--	--	not
MIL	*declining*	-0.28	not
RCN	*improving*	0.9	not
WPL	--	--	not

	Turbidity		
	Direction	*Slope*	*Signif*
BRZ	declining	0.4	95
CGR	declining	0.17	95
CHL	--	--	not
CUR	declining	0.17	95
GEE	declining	0.25	95
JNS	*declining*	--	95
MAT	declining	0.33	95
MIL	declining	0.33	95
RCN	declining	0.12	95
WPL	declining	0.17	95

Notes:
1. direction in *italics* indicates some evidence of a statistical trend but no associated slope could be determined
2. slope of the trend line
3. significance level of Seasonal-Kendall trend analysis results
4. direction in *italics* indicates some evidence of a change over time, but the trend is not statistically significant
5. slope of the trend line
6. significance level of Mann-Kendall trend analysis results

References

Hubler, Shannon and L. Merrick. January 2012. *Oregon Water Quality Index Summary Report Water Years 2001-2010*. Oregon Department of Environmental Quality.