Marine Water Quality

Every time we visit the beach, fish, or dig clams in Puget Sound, we rely on good water quality. Marine water quality in much of Puget Sound is poorer than we would like, especially in areas where the circulation of water is restricted.

The marine waters of Puget Sound are affected by many different factors including weather and climate, inflow from rivers and streams, discharges from wastewater treatment plants and industries, off-shore ocean conditions, storm-water runoff, and even ground water.

Excess pollution can force beach closures and shellfish harvesting restrictions, and may cause algae blooms that eventually deplete oxygen levels leading to fish kills.

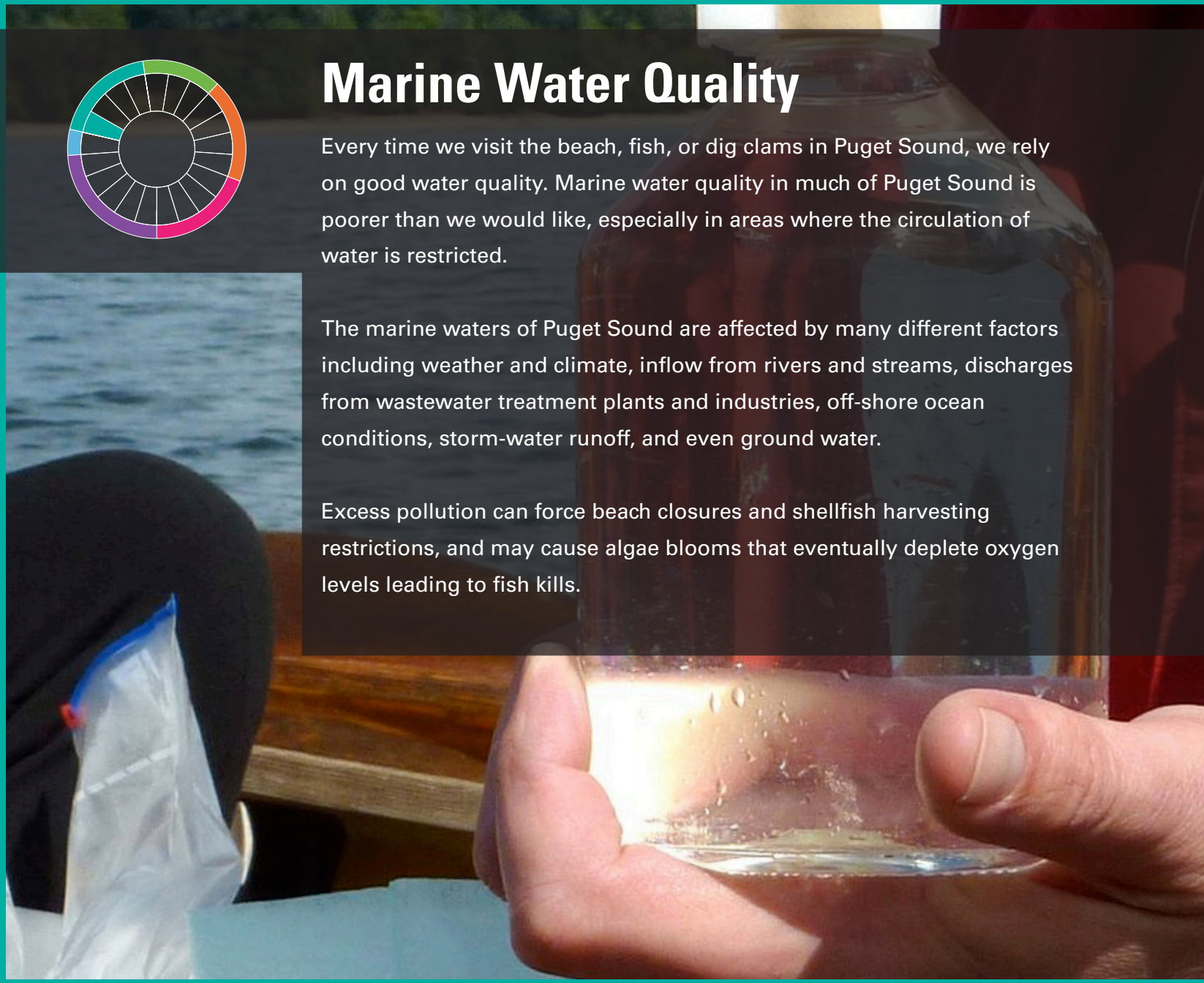


Photo Credit: Duane Fagergren, Puget Sound Partnership

Marine Water Quality

INDICATOR:

Marine Water Condition Index

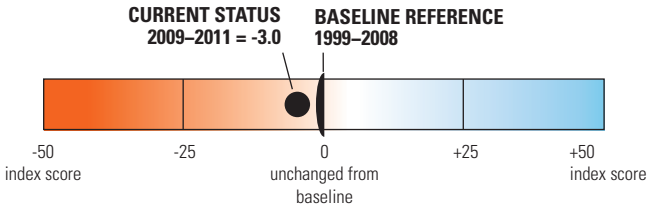
Indicator lead: Christopher Krembs, Washington Department of Ecology

TARGET:

The Leadership Council has not adopted a specific target for the Marine Water Condition Index. They did, however, adopt a target related to one key component of the index: Keep dissolved oxygen levels from declining more than 0.2 milligrams per liter in any part of Puget Sound as a result of human input.

PROGRESS:

IS THE TARGET MET?	NO	IS THERE PROGRESS?	NO



Using 1999–2008 as the baseline period with zero indicating conditions unchanged from the baseline, water quality conditions were slightly worse, on average, from 2009 to 2011.

Progress Towards 2020 Target

Marine Water Condition Index

Marine water quality was generally lower throughout Puget Sound in 2009 and 2010 relative to the ten year, 1999–2008 baseline. Conditions improved somewhat in 2011, with higher index scores reported in every one of the 12 regions monitored (Figure 1).

Dissolved Oxygen

For the most part, comprehensive studies to evaluate human contributions to low dissolved oxygen have not yet been completed in Puget Sound. A number of previous studies have suggested human inputs may be contributing to low dissolved oxygen problems. However, a recent study of Hood Canal indicated that human releases of nitrogen were unlikely to be contributing to low dissolved oxygen in the main arm of the Canal. The same study found that human inputs to Lynch Cove (in the southern part of Hood Canal) may be cause for concern, although the available data remains unclear.

Additional studies will be required to refine current models and improve our understanding of the degree to which human inputs contribute to low dissolved oxygen problems in Puget Sound, and what management actions may be necessary to address them.

What Are These Indicators?

Marine Water Condition Index

The Washington State Department of Ecology developed the Marine Water Condition Index (MWCI) to better address the large amount of variability inherent in marine water quality measures, in order to detect subtle changes over time.

The MWCI integrates 12 variables that describe an important aspect of water quality conditions (e.g. temperature, salinity, nutrients, algae biomass, dissolved oxygen, etc.). The goal of the MWCI is to provide a framework that links changes in local water quality and physical conditions to a larger context of oceanic water quality and natural variability. The MWCI can detect subtle changes in water conditions relevant to eutrophication and physical conditions against site and seasonal-specific baseline conditions measured from 1999 to 2008.

The index is reported on a scale of -50 to 50 indicating a complete change from baseline conditions, with zero indicating unchanged conditions relative to the baseline. The index is reported for 12 regions (Figure 1).

Dissolved Oxygen

Low dissolved oxygen has been observed in a number of locations in Puget Sound and can create significant problems, such as extensive fish kills, human inputs, especially nutrients, are often suspected of creating, or exacerbating, the conditions which lead to low oxygen in Puget Sound. To reduce the frequency and severity of oxygen problems in Puget Sound, the Leadership Council adopted a target intended to minimize any human contributions to low dissolved oxygen in Puget Sound.

The problem is, dissolved oxygen naturally exhibits a high degree of variability in marine waters, changing almost continuously with time of day, location, season, tidal cycle, depth, the mixing and movement of different water sources, and many other factors. Also, there are several main sources of nitrogen entering Puget Sound, including the ocean (generally the largest overall source), terrestrial sources (some of which are natural, and some of which are human), groundwater, and the atmosphere.

Consequently, determining the precise degree to which human inputs are responsible for a relatively small decline in dissolved oxygen, relative to the normal range of variability, is a complex issue. Addressing the issue requires a combination of good monitoring data, studies on the sources of nitrogen, and sophisticated mathematical models.

Marine Water Condition Index Scores
1999-2011

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Admiralty Reach	20	13	8	4	0	-5	-3	-5	4	0	-3	-2	14
Georgia Basin	-2	14	13	1	-2	10	-2	-7	1	9	-9	7	16
South Hood Canal	16	7	9	3	-4	-9	-1	-11	6	10	-1	-14	-11
Central Basin	15	14	12	8	0	-6	-8	-3	4	1	-7	-10	7
Bellingham Bay	10	13	23	-3	1	6	-12	-8	7	2	-12	-14	7
Sinclair Inlet	8	16	13	1	-1	-6	-5	-11	4	1	3	-13	3
Oakland Bay	16	13	14	-4	-6	-9	-5	1	4	-3	1	-6	1
South Sound	19	14	14	-2	4	0	-4	-2	3	0	-8	-12	9
Elliot Bay	28	19	5	-3	-9	3	-15	-9	3	4	-8	-5	5
Commencement Bay	17	8	13	-3	-6	0	-3	-1	7	-5	-8	-8	2
Whidbey Basin	11	8	8	-5	-2	-10	-1	1	9	7	-9	-14	-3
Budd Inlet	8	14	17	1	-12	-9	-7	-1	8	5	3	-8	1

Figure1. Marine Water Condition Index scores for twelve regions of Puget Sound, between 2001 and 2010. Changes in water quality relative to the 1999 to 2008 baseline are reported, with numbers greater than zero indicating improving water quality (in green), and numbers smaller than zero indicating decreasing water quality (in red).
Source: Washington Department of Ecology, Environmental Assessment Program, Marine Monitoring Unit

Marine Water Quality

Interpretation of Data

Status and trend

Marine Water Condition Index scores have generally declined over the past ten years, illustrated by a shift from green to red colors and an increase in negative scores (Figure 1). These results indicate that conditions overall are shifting in the direction of lower water quality, although recent, more stable conditions have slowed the apparent decline. The largest changes, more than 20% decline, were in South Sound, Bellingham Bay, and Central Sound.

The largest driver of declining marine water quality has been nitrate concentrations. Over the past ten years, nitrate levels have increased significantly. Because nitrate is an important plant nutrient, increasing nitrate loads can fuel algae blooms which, as the algae subsequently die and decay, can drive low dissolved oxygen events.

There are two dominant sources of nitrate in Puget Sound waters: input from ocean waters flowing into Puget Sound and human pollution. Recent evidence suggests that increasing nitrate loads to Puget Sound are predominately non-oceanic. However, as discussed earlier, the overall contribution of human inputs to low dissolved oxygen in Puget Sound remains a topic of active study.

Rain Gardens to the Rescue

Puyallup Gets Disconnected

Since 2009, the City of Puyallup has educated hundreds of citizens on stormwater pollution prevention through its Rain Garden Program. As a result, more than one million gallons of stormwater were disconnected from the city's stormwater system.

Although stormdrains are designed to collect and carry stormwater, they do not treat the water before it is channeled to Puget Sound through our streams, lakes, and rivers. Our streams and rivers were not intended by nature to carry these large volumes of stormwater. This runoff carries pollutants from our yards and roads into the waterways that are dumped untreated into Puget Sound.

Rain gardens are a beautiful way to manage stormwater runoff naturally where it originates, rather than letting it flow into the stormdrains. Planting native perennial flowers, shrubs, and grasses in a shallow flowerbed helps reduce flooding by capturing stormwater that runs off hard surfaces such as driveways and sidewalks. Rain gardens remove oil, grease, and other pollution by filtering water through layers of soil and plant roots before recharging groundwater supplies.

The city of Puyallup is creating demonstration sites to

Rain Gardens to the Rescue

LOCAL STORY

educate the public on stormwater issues and how each homeowner and business can work to minimize their impervious footprint in our watershed. Other ways to keep runoff out of the stormwater system include harvesting rainwater in a rainbarrel or cistern and installing porous pavement on your property. Rooftop gardens are also another option.

Since the program began, 62 rain gardens, including seven large rain garden clusters, have been installed in Puyallup. By coordinating with homeowners to install grant-funded rain gardens and other GSI at private homes, we are also helping our citizens to beautify their yards and neighborhoods and build community relationships.

Funding for Puyallup's Rain Garden Program came from Washington State's Department of Ecology grant programs as well as donations from several local businesses and individuals.