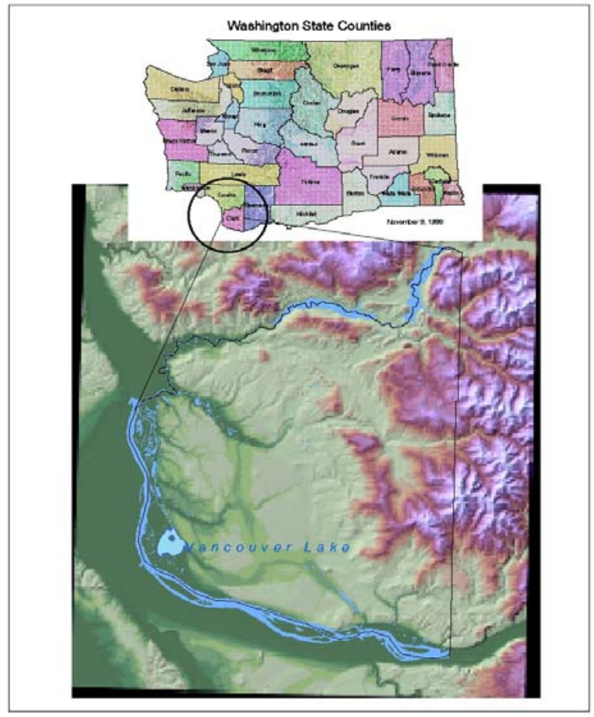
Vancouver Lake 2006 Volunteer Monitoring Data Summary

Lake Description

Location

Vancouver Lake is situated in the Columbia River floodplain in southwest Clark County, west of the city of Vancouver, Washington. The lake and surrounding watersheds are positioned at the base of the foothills of the Cascade Range to the east and the Pacific Coast Range to the west. The lake is part of the Willamette Valley ecoregion, which extends south into Oregon.



Size and Morphology

Vancouver Lake is one of several large, shallow lakes in the lower Columbia River floodplain. It may have been formed by a series of Missoula Floods coursing through the Columbia River channel, and then further worked by the river itself with seasonal inundation.

Vancouver Lake Morphology

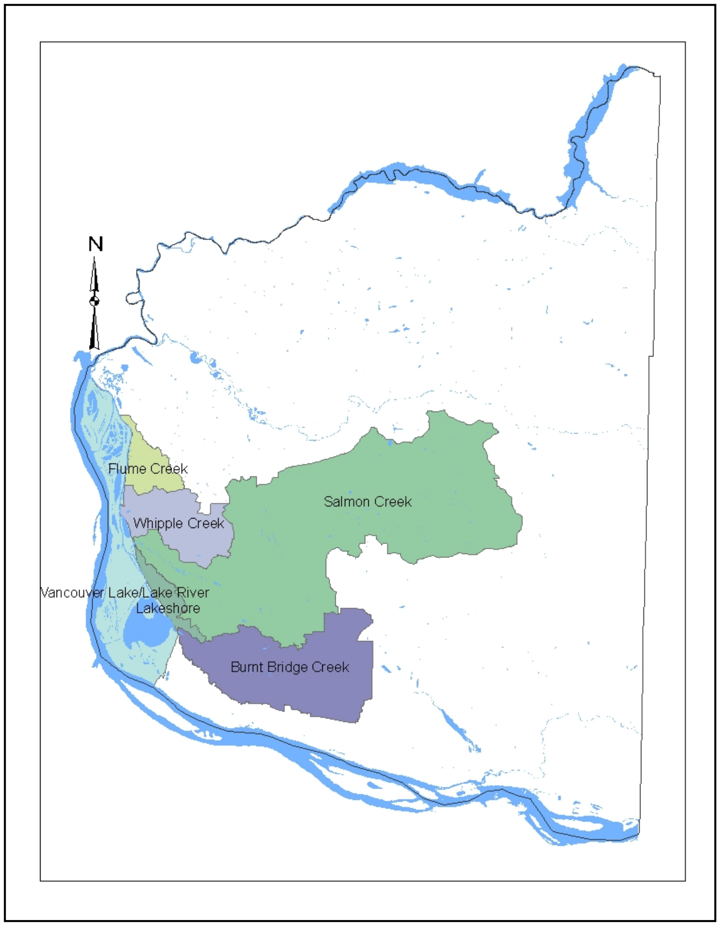
Historically, the lake was connected to the Columbia River through Mulligan Slough to the south and Lake River to the north. Diking and filling along the south and west lake shoreline and the Columbia's shoreline led to the eventual separation of the lake and the river.

Major tributaries to the lake include Burnt Bridge Creek, small tributaries along the eastern shore, and intermittently, Lake River, which can flow in or out depending on water levels in the lake relative to the Columbia River. When Lake River flows into the lake it potentially carries water from the Whipple, Salmon, and Flume Creek watersheds. A flushing channel, constructed along the southwest shoreline, also acts as an intermittent tributary carrying a significant amount of water from the Columbia River.

Vancouver Lake has a surface area of about 2,300 acres and a maximum width of over two miles. Its depth varies greatly through the season as lake water levels fluctuate with the level of the Columbia River. However, the lake is generally considered to be very shallow with a mean depth of less than three feet and a maximum depth of about 12-15 feet near the dredged area at the mouth of the flushing channel. The lake's deepest parts are located along the east and west shorelines, in channels along the margins of the lake, leaving the majority of open water near the middle of the lake less than four feet deep throughout much of the year (for more detail see Vancouver Lake Characteristics Table and Relative Water Depth Graphic on page 13).

The lake's shoreline is over seven miles long and is very uniform with very few backwater bays or inlets. Development of the shoreline is minimal because much of the land is in public ownership. A few residences dot the eastern shore, but the majority of land is held in open space as farms and pasture, wildlife habitat, and parks.

Watershed



Defining the extent of the Vancouver Lake watershed is not an easy task because the hydrology of the lake is complex. There are only a couple of drainages that *continually* supply water to the lake: Burnt Bridge Creek and the land surrounding the lake, which includes the adjacent floodplain and hills to the east known as the Lakeshore area.

Burnt Bridge Creek drains a 28 square-mile watershed that contains mostly urban areas (Clark County, 2004). Extensive data about the creek shows its health to be poor. The lands adjacent to the lake itself, including the Lakeshore area, are located primarily within the Columbia River floodplain. Although most of the Vancouver Lake and Lake River area is a wildlife refuge and farmland, many of the streams draining to these areas flow through urban, suburban, and rural areas (Clark County, 2004).

The primary outlet of the lake is a slow, flat slough of the Columbia River called Lake River. Numerous streams, including Salmon, Whipple, and Flume Creeks flow into Lake River along its eleven miles (Clark County, 2004). Seasonally high flows and tidal fluctuations in the Columbia River affect the flow direction of Lake River, often reversing its flow for long periods of time. This flow-reversal in Lake River effectively increases the lake's watershed to include these tributaries, an area encompassing over 100 square miles. Land uses range from rural to urban in these watersheds, and the creeks are generally poor in health due to extensive development.

Lastly, the flushing channel located on the southwest shore allows Columbia River water to intermittently enter the lake. Water from the Columbia River originates from a vast area extending hundreds of miles inland. The water quality of the flushing channel has not been extensively studied, although monitoring stations located in the Columbia River indicate the quality of water to be very good.

Monitoring Activity Summary

Volunteer Monitoring

Utilizing trained volunteers to collect environmental data is a growing trend among public agencies and private organizations across the country. Agency staff realize that they can expand limited resources by using trained volunteers, giving rise to the testing of more streams and lakes more often. Over the years, studies have demonstrated that data collected by volunteers can be credible and useful if volunteers are properly trained and equipped. The Clark County volunteer monitoring program is a good example of this trend. Citizen volunteers interested in the county's streams and lakes have collected excellent water quality data. Staff from the county's Water Resources Program train, equip, and manage the activities of the volunteers and also guide their monitoring efforts. Data from the volunteer sites augments the water quality data collected by water resource professionals and gives the county more information to manage natural resources.

Volunteer Activity

Volunteer monitoring began on Vancouver Lake in the summer of 2003 with a student working on a school project. With the assistance of Water Resources, the student conducted testing to determine the trophic status of the lake (Wong, 2004).

In response to increasing community interest in the lake, especially from existing volunteers, county staff orgainized a volunteer team to monitor the lake the following year. Water quality monitoring was conducted eight times by the Dragonfly team from June 2004 to October 2004 (Wierenga, 2004). Additionally, the program supported another student's project designed to investigate the differences in water quality between the flushing channel, mixing zone, and open lake water (Bufford, 2005).

A team of about 10 volunteers continued monitoring the lake's water quality in the summers of 2005 and 2006, completing 11 sampling events each year between the end of May and the end of October.

Methods

The details of the Vancouver Lake monitoring project are described in the project's quality assurance project plan (QAPP). Volunteers are trained by county staff each spring before the field season begins. Volunteers use standardized procedures for performing environmental measurements and collecting samples (Wierenga, 2003). The procedures involve the use of simple tools, such as Secchi disc depth measurements of water clarity, as well as using high-tech instruments for measuring dissolved oxygen and pH levels. Water samples are collected using equipment designed specifically for lake sampling. Samples are collected mid-lake to test general lake conditions, away from the localized influence of the flushing channel, Burnt Bridge Creek, or Lake River. Field measurements include vertical profiles for water temperature, pH, dissolved oxygen, and conductivity, as well as a single measurement of turbidity and Secchi depth. Water samples are analyzed for inorganic and total phosphorus and nitrogen, and for chlorophyll-a concentrations. Samples are also analyzed for the amount and types of different algae.

Water Resources staff lead and coordinate the twice-monthly sampling from late May to October. In some cases, volunteers are responsible for picking up and returning equipment and samples, as well as providing their own on-lake transportation. Several access points on public and private property have been secured to help facilitate volunteer needs.

Data Management and Analysis

Volunteers are provided standardized data sheets for recording field observations and measurements. Staff reviews the field data sheets and analytical data for completeness and quality control. Data are stored in hard copy in three ring binders at the county office until the completion of the sampling season, and then it is entered into the county's database.

Data analysis focuses on the assessment of lake condition, specifically on the level of algal growth and related parameters. Basic summary statistics showing central tendency and variability of the data are calculated on seasonal datasets and summarized in tables, such as Table 1 in this report. Data are also displayed using simple graphics, such as time series plots.

A Trophic State Index (TSI) is used to describe the level of production of a lake, or the amount of algal matter produced by photosynthesis in a lake. Indices integrate complex datasets, provide a common reference point to describe lake conditions, and help track changes over time. A single measurement of TSI does not indicate whether a lake's health is deteriorating, nor does it imply where a lake *should be* in terms of the current health.

Lake Conditions

Studies since the late 1960's show that Vancouver Lake has poor water quality and that lake uses can be severely limited in the late summer due to intense algal blooms (Bhagat and Orsborn, 1971; Cooper Consultants, Inc, 1985). Extremely high levels of phosphorus and nitrogen, high water temperature, and high turbidity levels contribute to the occurrence of nuisance bluegreen blooms. The results of water quality monitoring by Clark County volunteers generally support previous conclusions regarding the poor condition of the lake. Data has shown that lake conditions are highly variable though, both from season to season and from year to year. Datasets from the 2004, 2005, and 2006 volunteer monitoring programs were quite different with respect to many of the characteristics, underscoring the importance of collecting several years of baseline data (see Table 1 for summary of values). While conditions in 2006 generally improved, many of the tests still indicate that the lake was highly enriched with nutrients and algae.

Water Clarity

Vancouver Lake has very poor water clarity. Secchi depth readings are typically deeper in the spring and become shallower through the summer and early fall as water clarity deteriorates. The 2004 summer average reading was about 0.20 meters and ranged from 0.10-0.40 meters. Water clarity improved in 2005 with an average summer Secchi depth value of 0.40 meters and a range of about 0.20-1.0 meters. In 2006, water clarity was very similar to that of 2005, with an average summer Secchi also of 0.40 meters and a range of 0.1 to 1.1 meters.

Typical summer turbidity is about 60 NTU but can range from 25-175 NTU. Turbidity values were typically lower in 2005 compared to the previous year. In 2006, summer turbidity values were substantially lower than in the previous two years with an average of 41.5 and a range of 7.6 to 98.2 NTU.

The lake's great size and shallow depth, coupled with the rather simple shoreline morphology, leads to frequent wind-induced mixing. The lake's bottom sediments are fine grained and unconsolidated, thus are easily re-suspended. Fish also actively disturb bottom sediments searching for food. Intense algal blooms also limit light penetration.

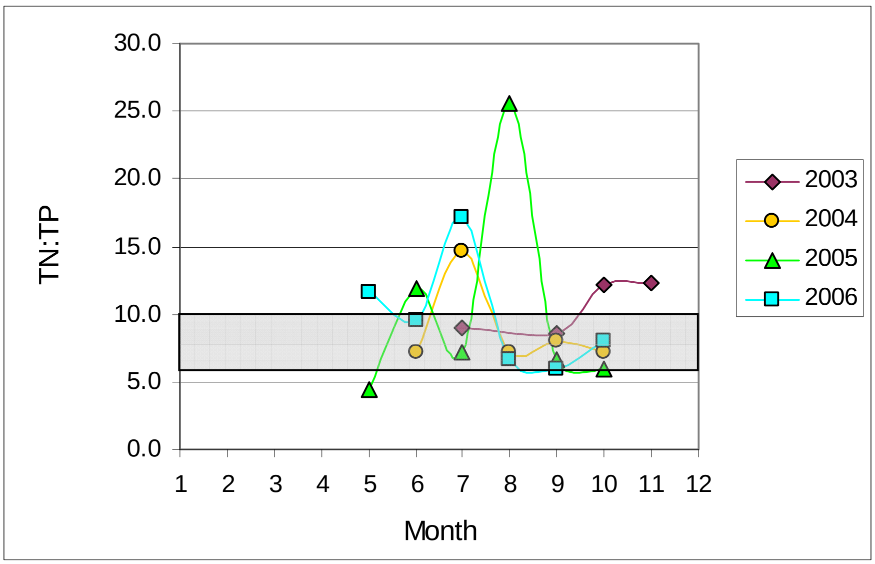
Nutrients

Vancouver Lake has high levels of nutrients. The total phosphorus criterion for preventing the development of biological nuisances and to control eutrophication in lakes is 25 *u*g/L (EPA, 1986).

Vancouver Lake often has phosphorus levels ten times higher than this criterion throughout any summer. And while in the summer 2005 and 2006 total phosphorus values were much lower than in 2004, they still exceeded the criterion (Table 1). Total nitrogen levels are also typically high and variable.

The biologically available forms of nitrogen and phosphorus increased sharply in late July and early August in 2004, coinciding with periods of heavy algal growth. This pattern was repeated only by ammonia-N in early July of 2005, whereas other inorganic forms of phosphorus and nitrogen remained relatively low throughout most of the 2005 summer. In 2006, there was a spike in nitrate and ammonia earlier in May and later increases in mid-August for orthophosphate and ammonia followed by an even later spike in nitrate in late September.

An important aspect of nutrient levels in lakes is their availability to algae. The ratio of total nitrogen (TN) to total phosphorus (TP) is often used by scientists to interpret the availability of nutrients relative to one another. Low ratios indicate an abundance of phosphorus relative to nitrogen. Higher ratios indicate a scarcity of phosphorus relative to nitrogen. The ratio in Vancouver Lake varied from month to month, particularly in 2005 relative to 2004. Typical summer values were similar and centered around a ratio of about seven. In 2006, the ratios were very similar to those of 2004 except for a higher ratio in May, but the median was closer to nine.



Total Nitrogen (TN) to Total Phosphorus (TP) ratio during the summer months in 2004, 2005 and 2006; the shaded region represents potential co-limitation of algal growth by phosphorus and nitrogen.

The values indicate the potential for both nitrogen and phosphorus to limit algal growth at any given time. If nutrient control is identified as an important improvement strategy, then controlling sources of both nitrogen and phosphorus may be important.

Oxygen/Temperature

Vancouver Lake is very warm and does not exhibit widespread oxygen depletion. Vertical profiles of oxygen and temperature show that the lake does not typically stratify, or separate into layers by temperature. Water temperature is variable throughout the summer and is considered to be very warm, with surface temperatures sometimes reaching 25 degrees Celsius, or about 77 degrees Fahrenheit. The warm water suits particular types of algae, such as bluegreen algae, that are capable of developing into nuisance algae blooms. While the average water temperatures were both less than one degree Celsius lower in 2005 and 2006 relative to 2004, the maximum observed temperatures were about two degrees Celsius lower and higher in 2005 and 2006, respectively. These results reflect the year to year variability for the limited monitoring done so far.

The lake is frequently mixed by wind, distributing oxygen throughout the water column. Oxygen levels vary, from supersaturated conditions near the surface as a result of algae photosynthesis, to somewhat depleted levels near the bottom during times of stagnant wind conditions. The lowest levels of oxygen were in the deeper waters and consisted of about 3, 5, and 6 mg/L in 2004, 2005, and 2006 respectively. Oxygen depletion (also called an oxygen demand) results from the decomposition of biological material that settles to the lake bottom. This demand often uses up the oxygen in the bottom layers of eutrophic lakes.

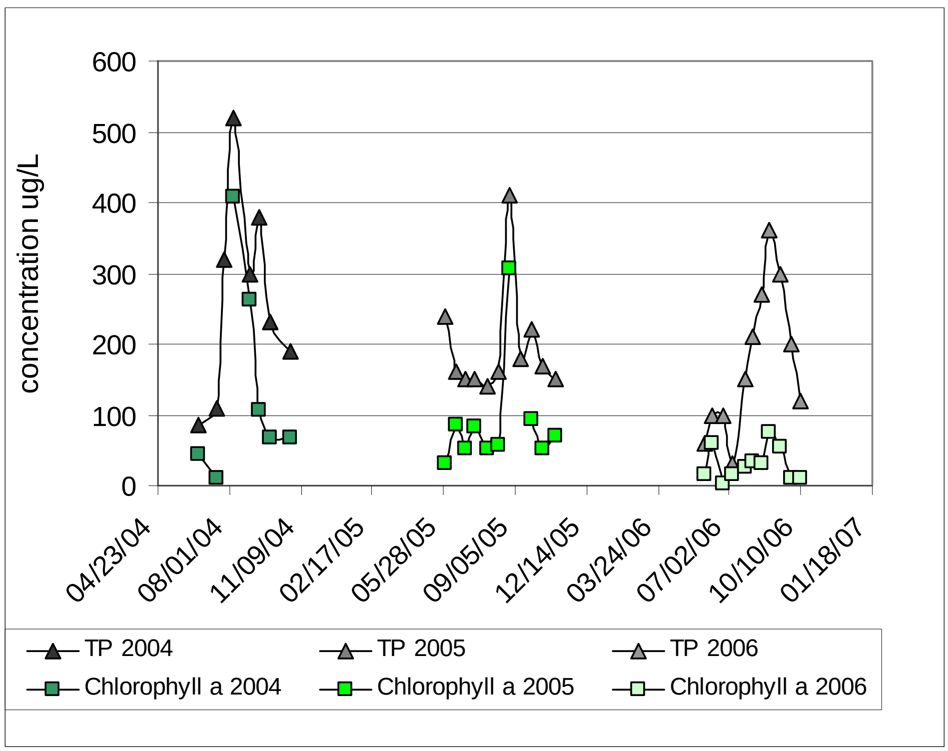
pH

Vancouver Lake has very high pH levels. Data show that pH levels are typically highest during July and August, most likely as a result of intense algal growth. Typically, aquatic criteria that limit impacts to organisms require that pH levels remain somewhat neutral to slightly alkaline, not to exceed a value of 8.5-9.0 units (EPA, 1986). pH levels are routinely above 9.0 units in the mid-summer months. Rapidly growing algae can have a significant impact on overall lake chemistry. A rapid increase in pH can cause, for example, increased ammonia-nitrogen concentrations that are toxic to fish (EPA, 1986). Vancouver Lake pH levels are variable and are likely closely related to algal growth. Average pH values were lower in 2005 relative to 2004, supporting several other observations that indicated less intense algal blooms. However, the 2006 average and range of pH values were very similar to those of 2004.

Algae

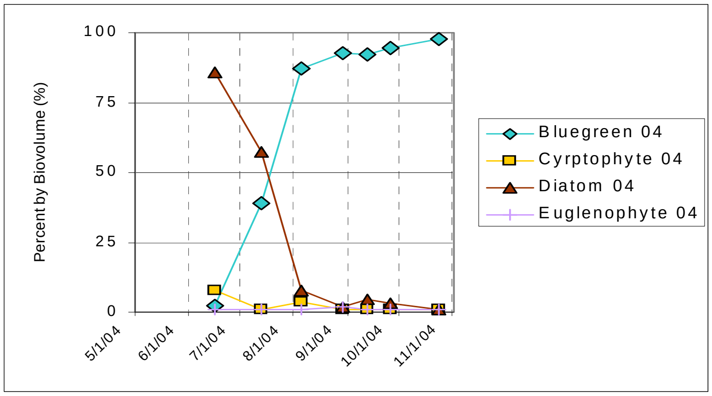
Chlorophyll-a concentrations and algal counts are used to estimate the amount of algae in the lake. Both tests indicated very high levels of algae, with a very rapid increase in values between mid-July and mid-August.

Chlorophyll-a, a pigment present in algae that is used for photosynthesis, is often used to estimate the amount of algae in a lake. Eutrophic lakes typically have maximum chlorophyll-a concentrations ranging between 20 and 200 *u*g/L (Holdren and others, 2001). Vancouver Lake's average chlorophyll-a concentration was 138 *u*g/L in 2004 and reached a maximum of 409 *u*g/L in early August. In 2005 the average value was lower at about 89 *u*g/L and reached a maximum of 307 *u*g/L. In 2006, the average chorophyll-a was much lower at only 30 *u*g/L with a maximum of 75.3 *u*g/L. Chlorophyll-a and Total Phosphorus levels typically follow similar patterns in Vancouver Lake (see figure at right).

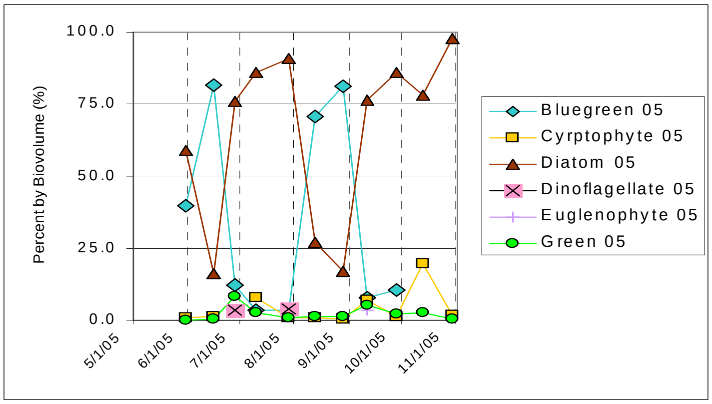


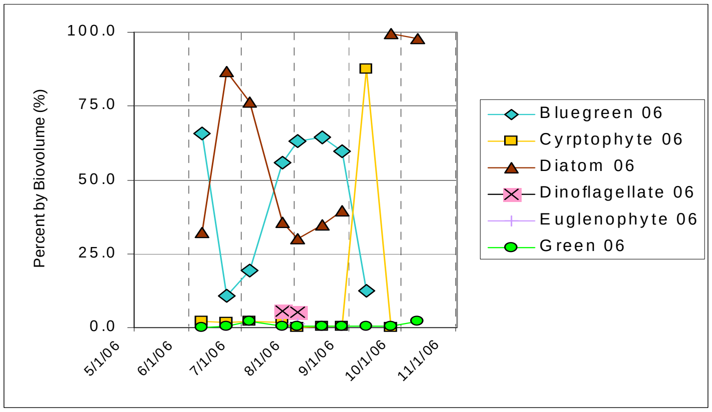
Levels of TP and algae, as indicated by chlorophyll-a.

Algal biovolume measurements also indicate very large amounts of algae that peak in early August and remain high into the fall. Algal communities, or the types of algae, were very different in the three years of study. In June 2004, the algal community was dominated by large diatom and cryptophyte algae that are suited to colder water with lower levels of nutrients (see figure to the right). Bluegreen algae were present in the early summer but represented a small proportion of the total community biovolume. The dominance of diatoms decreased by mid July and by early August bluegreen algae were most abundant. Bluegreen algae dominance was 95% and 98% in September and October, respectively.



The algal community in 2005 consisted of similar species and groups of algae, but the seasonal succession was completely different. Various species of diatoms persisted throughout the summer, trading dominance with bluegreens, primarily Aphanizomenon and Anabaena species. The percent of algal biovolume figures for diatoms and bluegreen algae nearly mirror one another (see figure to the right).





The 2006 algal community was more similar to 2005 than to 2004 but the timing and durations of cycles were different. Also in 2006, the cyrptophyte group peaked much higher at around 85% in September, mostly replacing the bluegreen and diatom groups. Several explanations are possible for these multiple year patterns, including conditions that were more favorable for the dominant group's growth, as well as the possibility that bluegreen blooms repeatedly crashed and were followed by diatom blooms.

Trophic State

Trophic state indices (for example, TSI as a relative estimator of lake algal or phytoplankton production [Carlson, 2007]) that were calculated from chlorophyll-a concentrations and algal biovolumes indicated that the lake is *hyper-eutrophic*. This means that the lake is highly enriched with nutrients and algae. The average chlorophyll TSI value for the summer of 2004 was 74 on a scale that goes to 100. Individual values ranged as high as 90 in August 2004. In 2005, the average chlorophyll TSI was similar at 73 and ranged as high as 87 in late August. The 2006 values were lower, with the average chlorophyll TSI at 60 and a maximum of 73 in late August.

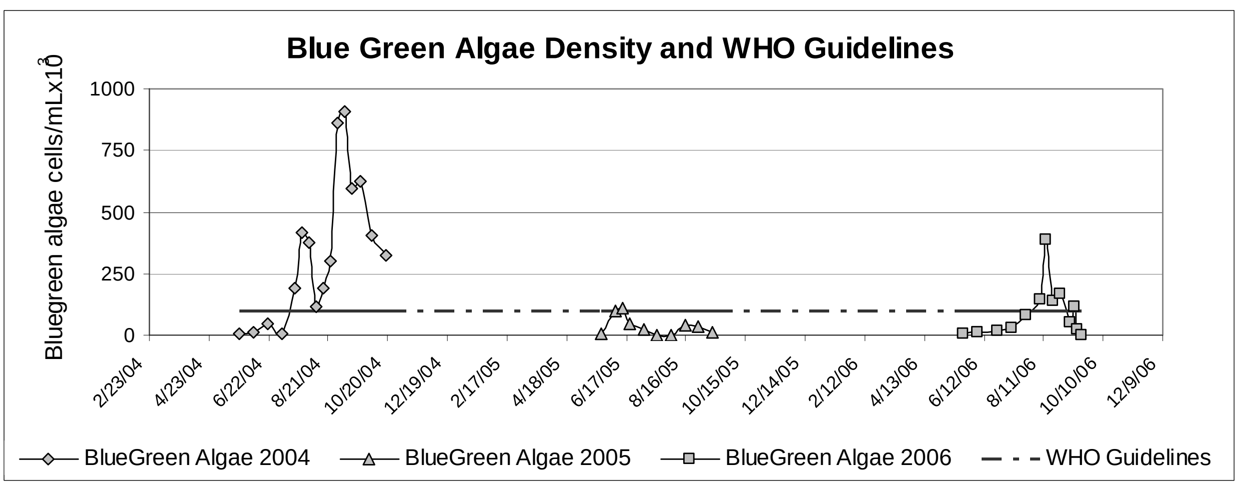
Human Health Concerns

There is an increasing amount of information about harmful bacteria or other pathogens in Vancouver Lake; levels of fecal coliform bacteria in various tributaries are known to be occasionally high. In 2004, the Clark County Health Department initiated an E. coli monitoring program at the Vancouver Lake Park swimming beach. The Health Department uses EPA bathing water standards and considers E. coli levels in lake water samples higher than 236 bacteria / 100 mL unsafe for swimming. The Health Department's bi-weekly beach monitoring reported E. coli maximums of 67 bacteria / 100 mL of water in 2004, no beach monitoring in 2005, and four results (276-727) higher than 236 bacteria / 100 mL for 2006. These results indicate conditions are usually suitable for swimming based on the E. coli criteria.

In 2005 the Washington State Department of Ecology included the Vancouver Lake swimming beach in its statewide E. coli monitoring program. Data indicated that bacteria levels were low throughout the summer, only reaching about 30 E. coli bacteria per 100 mL in September (Maggie Bell-McKinnon, WA Dept. of Ecology, unpublished data).

Levels of algae in the lake, in particular bluegreen algae, are of great concern. Higher blue green algae levels contribute to impaired aesthetics and the Health Department's recent swimming beach closures because of their potential toxins. As mentioned previously, existing data shows that the algal community is often dominated by bluegreen algae for most of the summer. Bluegreen algae are capable of producing toxins that can be harmful to wildlife, domestic animals, and people. The amount and type of algae found in a lake can be highly variable. As a result, the Clark County Health Department initiated a monitoring program at the Vancouver Lake Park beach to monitor bluegreen algae levels. The health department uses World Health Organization (WHO) guidelines and considers bluegreen algae levels in lake water samples higher than 100,000 cells per milliliter unsafe for swimming.

Sample results from 2004 showed that the concentration of bluegreen algae exceeded the WHO guidelines beginning in the second week of July. In fact, bluegreen algae levels reached nearly ten times the guideline value and forced the closure of the beach to swimming (see figure below). Bluegreen algae levels remained high through the end of the volunteer monitoring season in October of 2004.



Results from 2005 were very different. Bluegreen algae concentrations increased to the WHO threshold in early June, initiating weekly monitoring according to the Clark County Health Department guidelines. But values rapidly decreased and the lake's swim beach remained open to swimming for the remainder of the summer. In 2006, Bluegreen algae concentrations surpassed the WHO threshold in early August and remained above it throughout the month. The levels dropped slightly in early September but then rose just above it for a short period of time before dropping again.

The health department plans to continue monitoring and reporting the levels of bluegreen algae at the Vancouver Lake Park beach. The data is available on their website at: http://www.clark.wa.gov/health/environmental/beaches/Vancouver-Lake.html.

Aquatic Plants

In general, the lake is considered to be too turbid to support the growth of larger rooted aquatic plants because light does not reach the lake bottom. Previous studies have found very little aquatic plant material in the lake (Caromile and others, 2000). Comments from an August 15th, 1995 aquatic plant survey by the Washington Department of Ecology's lakes program showed "no plants observed, only walked shore at the inflow dilution canal, and the county park". The lake is shallow and has extensive amounts of nutrient-rich sediments available for aquatic plants to colonize if light penetration improves.

Fish

Vancouver Lake has mostly warm water game fish with a few seasonal visitors (Caromile and others, 2000). A fish survey in 1998 revealed many species of fish including brown bullhead, channel catfish, white crappie, black crappie, largemouth bass, bluegill, pumpkinseed, yellow perch, goldfish, common carp, northern pike minnow, American shad, mosquito fish, large-scale sucker, and sculpin (Caromile and others, 2000). White crappie, brown bullhead, and black crappie were most abundant, while brown bullhead, crappie, and carp accounted for most of the fish biomaterial in the lake. Overall, biologists concluded that *habitat availability* was a primary limiting factor, stating there was a "startling lack of structure or vegetation for habitat". Recommendations for managing the fishery included increasing angler's access through providing improved boat-launch access, providing more fish habitat structure, and educating the public about the benefits of angling for carp.

Juvenille salmonid species, including Chinook salmon and Steelhead trout, have been observed in the lake (Knutzen and Cardwell, 1984). Adult salmonids are less commonly captured but are known to exist in small numbers.

Waterfowl

The amount and distribution of waterfowl can have a significant impact on lake water quality. The lake and its shoreline are used by migrating and resident waterfowl. Vancouver Lake Park has a concentration of ducks and geese along its grassy and sandy swimming beach shoreline.

Summary

Overall the condition of the lake can be poor and sometimes limit recreational and aquatic life uses. However, the three years of data have shown conditions to be highly variable. Phosphorus levels are typically much higher than EPA's aquatic life criteria recommended to avoid nuisance algal blooms. The open-lake water is shallow, warm, and turbid from algae and sediment suspended during wind-induced mixing and by benthic fish activity. Oxygen levels are typically super-saturated due to photosynthesis but levels appear to decrease during calm weather conditions. The lake's pH levels are above state water quality standards during the periods of heavy algal growth. Light penetration is typically very low, with Secchi disc depth readings ranging from 0.1 to 0.5 meters in the summer. Water clarity in the spring appears to be better.

The lake's overall health is similar to conditions described in previous investigations. It is difficult to conclude at this point whether the lake is getting better or worse, or maintaining a stable, steady-state.

Recommendations

The local community is beginning to learn more about the current water quality and condition of Vancouver Lake. Mid-lake monitoring by volunteers should be continued to provide information about current conditions and to better understand the variability of the data. The Clark County Health Department should maintain its current bacteria and algal monitoring program at popular bathing beaches. Local and state agencies should also continue monitoring programs on the major tributaries including Burnt Bridge, Salmon, and Whipple Creeks. Importantly, the Vancouver Lake Watershed Partnership (VLWP), a group of local and state agencies and members of the public, have recently been working together to improve the lake. Monitoring activities conducted by the VLWP have begun to fill in data gaps.

Acknowledgements

Thank you to the members of the monitoring team for their hard work in 2006: Judy Bufford, Tim Dean, Cory Samia, Adrienne Hale, Monty Multanen, Cesile Cocks, Carlos Ocejo, Bill Ward, Jerry Armstrong, and Eldon Edwards.

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Special thanks to the Vancouver Lake Sailing Club for allowing volunteers to access the lake, and to these specific members: Ed Bourguignon, Randy Anderson, Jerry Martin

Volunteer Monitoring Program

Volunteer monitoring is supported by the Clark County Public Works Water Resources Section's Clean Water Program. If you are interested in becoming a Volunteer Monitor or using Clark County water quality monitoring equipment, contact Clark County Water Resources at (360) 397-6118 extension 4345 or see the website listed below.

More Information on Vancouver Lake

For more information about the water quality of Vancouver Lake contact:

Ron Wierenga
Clark County Public Works
(360) 397-6118 ext. 4264
Ron.Wierenga@clark.wa.gov

Or, visit the Clean Water Program website:
www.clark.wa.gov/water-resources/index.html

Table 1. Average values for water quality monitoring projects; values in parentheses are ranges for the period

Data Source	Date Range	Water temperature *(dec-C)*	Minimum water column oxygen concentration *(mg/L)*	pH *(units)*	Secchi Depth *(meters)*	Turbidity *(NTU)*	Total phosphorus *(ug/L-P)*	Total nitrogen *(mg/L-N)*	Chloropyll-a *(ug/L)*
Bhagat and Funk, 1968	June to September 1967	22.3 (19 – 25)	8.0	8.1 (7.1- 8.9)	-	43 (6-62) (JTU's)	360 (190 – 530)	2.85 (0.8 - 5.4)	-
Cooper Consultants	July 1981 to October 1982 *Average values only	18.2	9.9	7.9	0.27	79	250	-	70
WA Ecology	May 1990	18.1	9.6	7.9	-	-	66.4	0.31	-
WA Ecology and volunteer	June to August 1990	-	-	-	1.4 (0.5-2.5)	-	-	-	-
WA Ecology and volunteer	May and September 1995	24.3 (23.9 - 24.8)	6.9	9.2 (9.0-9.3)	0.61	-	143.3 (74.7–212)	0.68 (0.61-0.74)	32.7 (29.6-35.8)
Volunteer (Clark County)	July and September 2003	20.7 (19.2-22.1)	6.8	8.2 (8.1-8.3)	0.25	50.3 (40.5-60.1)	165 (150-180)	1.43 (1.33-1.52)	-
Volunteer (Clark County)	June to October 2004	20.7 (12.4-25.1)	3.3	8.9 (7.9-10.1)	0.18 (0.1-0.4)	71.2 (27.9-173.0)	267 (86–520)	2.27 (0.62-3.56)	137.9 (95-409)
Volunteer (Clark County)	May to October 2005	19.9 (12.4-23.4)	5.2	8.4 (7.2-9.4)	0.39 (0.2-1.0)	72.6 (28.6-176.5)	194 (140-410)	2.66 (0.82-16.1)	88.8 (32-307)
Volunteer (Clark County)	May to October 2006	20.1 (14.4-27.8)	6.1	8.9 (7.5-9.9)	0.40 (0.1-1.1)	41.5 (7.56-98.2)	172.7 (30-360)	1.3 (0.7-2.56)	30.2 (1.4-75.3)

Vancouver Lake Characteristics

Lake Area:	2,300 acres
Watershed Area:	42 sq. miles (Burnt Bridge Creek, Lakeshore, and Vancouver Lake watersheds only)
Maximum Depth:	13 feet
Average Depth:	5 feet
Shoreline Length:	9 miles

Vancouver Lake's Relative Water Depth (contours in feet based on GPS and Depthfinder data collected by Spenser Vines as part of his Eagle Scout project work. October 11, 2004).

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