

**Debbie Beadle**

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**From:** Evan Maxim  
**Sent:** Tuesday, July 31, 2012 8:15 AM  
**To:** Debbie Beadle  
**Cc:** Kathy Curry; Carl de Simas; Kamuron Gurol; Susan Cezar  
**Subject:** FW: corrected Welch response  
**Attachments:** 12-05384-000 Krabbe letter 072712.pdf

Corrected public comment...

*Evan Maxim  
Senior Planner  
City of Sammamish  
425.295.0523*

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**From:** Greg Krabbe [<mailto:gkrabbe@comcast.net>]  
**Sent:** Friday, July 27, 2012 3:56 PM  
**To:** Evan Maxim  
**Subject:** corrected Welch response

Evan, apparently the first version of our Welch response was only a draft. Please disregard and enter this one into the record. Thanks.

Greg Krabbe  
GFK Consulting Inc  
425 347 2898

EXHIBIT NO. 184.



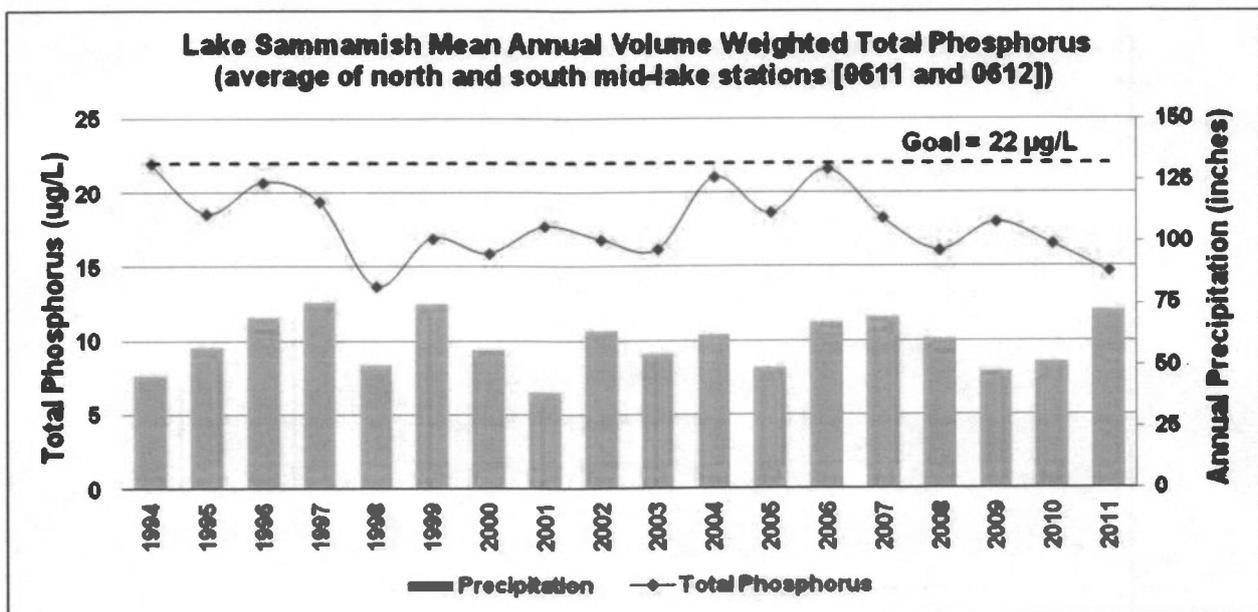
July 27, 2012

Mr. Greg Krabbe  
KKBL Ventures 575 LTD  
335 Park Place Center, Suite G111  
Kirkland, WA 98033

Subject: Lake Sammamish Total Phosphorus Trend Analysis

Dear Greg:

As you requested, this letter presents the revised chart of annual volume-weighted total phosphorus (TP) concentrations in Lake Sammamish from 1994-2011 (means of stations 611 and 612). Dr. Welch noted in his testimony on July 11, 2012, (Exhibit 164) that the TP values for 2009-2011 were incorrectly calculated by King County. King County scientist Debra Bouchard provided me with the corrected data on July 11, 2012. The corrected data were used to revise the chart presented in Slide 6 (Total Phosphorus in Lake Sammamish) at the planning commission meeting on June 14, 2012, and provided in my letter to you on June 15, 2012. The corrected data presented below also apply to the chart comparing lake TP to the percent cover of urban development (Slide 7 - Watershed Development). Annual precipitation amounts have been added to the chart below for comparison of lake TP to the relative amount of stormwater input, using data from King County rain gauge 14U located on the East Fork of Issaquah Creek.



We analyzed the corrected lake TP data for long-term trends using the Kendall's tau statistical trend test. The test of the entire 1994-2011 period yields a probability value (p value) of 0.16, indicating that the slight decreasing TP concentration observed (slope of -0.1 ug/L per year) is not significant over this time period at a significance level of 0.05 (or 5 percent chance of being wrong) because p value exceeds this level. However, the lack of an increasing trend in lake TP during this 17-year period of increasing watershed development (as shown in Slide 7) is encouraging.

Lake TP concentrations for the recent 2006-2011 period have exhibited a significant decline ( $p = 0.04$  with slope of -1.1 ug/L per year) since implementation of increased stormwater control requirements by King County's 2005 surface water design manual and Ecology's 2005 general construction stormwater NPDES permit. The significant lake TP decline observed over the past 5 years does not appear to be related to the amount of rainfall and associated stormwater input, as indicated by the annual precipitation amounts shown on the revised chart.

The observed lake TP concentrations are directly related to TP input from both the watershed and lake sediments. Watershed input (external loading) of TP is primarily a function of stormwater TP concentration and volume. Increasing stormwater controls likely reduced stormwater TP concentrations in recent years due to increased sediment and TP retention in developing and developed areas, and may have reduced stormwater volume from increased infiltration. Lake sediment input (internal loading) of TP is a complicated process that primarily depends on the amount of oxygen in the bottom waters (hypolimnion), but also depends on the amount of recent TP input from the watershed that settles to the lake sediments. The decline in hypolimnion TP observed by Dr. Welch may be due, in part, to a decline in TP input during the wet winter months when the lake receives most of the stormwater input that mixes in the lake water column (when the lake is not thermally stratified) and settles to the bottom sediments. Thus, it is reasonable to expect lower TP input from sediment when there is lower TP input from stormwater. It is not reasonable to expect that the long-term effect of sewage diversion in the 1960s accounts for the recent decline in lake TP concentrations.

In summary, TP concentrations in Lake Sammamish have significantly decreased over the past 5 years. This trend was likely due, in part, to increasing stormwater management efforts to control sediment and TP export from new and existing developments in the Lake Sammamish watershed. More data are needed to determine if this trend will continue, and more data analysis is needed to determine the extent of water quality benefits from improved stormwater management regulations and compliance. The lack of an increasing trend in lake TP during this period of increasing watershed development is encouraging.

Finally, I would like to comment on Dr. Welch's comment about the observed impact of increased stormwater discharge on stream erosion and phosphorus loading by development in the Timberline area. The study he references (Booth and Henshaw 2000) compared erosion

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measurements in two stream channels draining to the east shore of Lake Sammamish from the Timberline area. One stream channel (0143G at 48 percent slope) exhibited significant erosion (over 1 meter) due to stormwater input from upland development. The other stream channel (0143F at 14 percent slope) did not erode because the Timberline Ridge development was properly designed to discharge stormwater directly to an outfall in the lake to prevent erosion of this stream channel. I monitored water quality impacts of the Timberline Ridge development on this stream for 10 years between 1992 and 2002. The Timberline Ridge development is an example of how stormwater runoff can be properly managed to prevent increased sediment and TP loading from stream channel erosion. This example also supports my statement that stormwater TP inputs are not necessarily higher for developments located closer to the lake where stream channel and soil erosion can be prevented.

Sincerely,

Herrera Environmental Consultants, Inc.



Rob Zisette  
Water Quality Principal