

North Creek
Water Quality Monitoring Report
2013

Prepared for the City of Bothell, WA.

Snohomish County Public Works Surface Water Management
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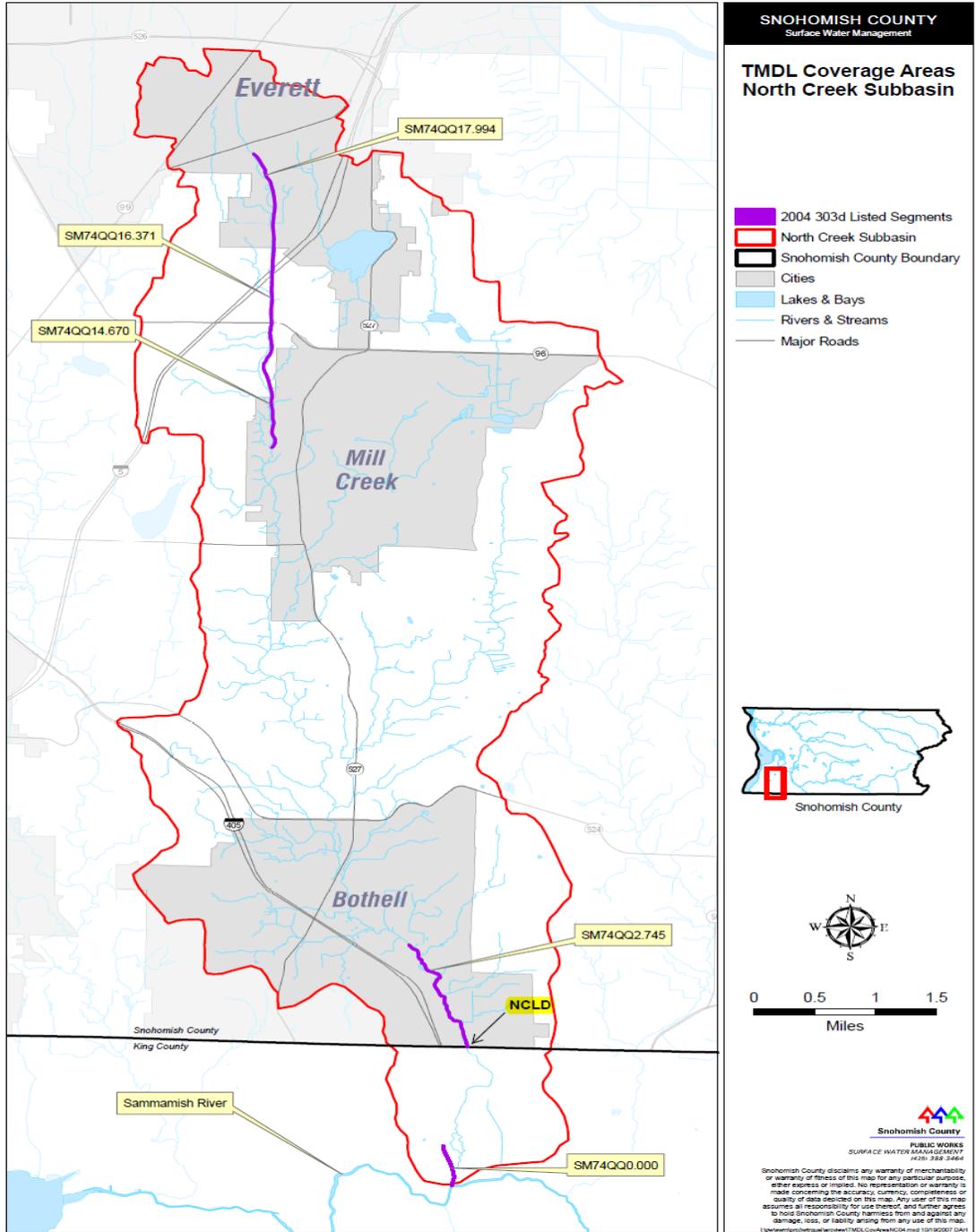
Introduction and Study Area

The City of Bothell (City) and Snohomish County (County) have a long standing inter-local agreement (ILA #9710070097), which allows the County to provide water quality services to the City. Water quality services are agreed upon annually. In 2013, services included routine water quality monitoring at one location to determine compliance with State water quality standards (Figure 1).

The following report satisfies the County's obligation to the City for water quality services in 2013.

On December 30, 2013 the City and County entered into a new ILA which refines, updates and supersedes ILA 9710070087. Section 4.1 of the 2013 ILA describes water quality monitoring services. A copy of the 2013 ILA is included in appendix A.

Figure 1. North Creek Sub-basin and Sampling Location



Background

The County has carried out surface water quality monitoring on North Creek at the County line (NCLD) since 1992 (Figure 1). Monitoring data are compared to surface water quality standards to determine suitability for aquatic life and risk to human health.

The Washington State Department of Ecology (Ecology) is responsible for establishing and implementing surface water quality standards. Washington State Administrative Code (WAC 173-201A) contains these standards.

North Creek at NCLD is classified in the Washington State Water Quality Standards (WAC 173-201A) as extraordinary contact recreation. The classification requires that:

- Fecal coliform organism levels must not exceed a geometric mean value of fifty colonies/100ml, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding one hundred colony forming units (cfu) / 100ml.

Those standards applicable to North Creek and parameters monitored for the City are found in table 1.

Table 1. Washington State Water Quality Standards for Measurements at NCLD

Waterbody	Fecal Coliform Bacteria Standards Colonies/100ml		Dissolved Oxygen mg/l Lowest 1 day minimum Core Summer Habitat	Temperature Deg C Highest 7-DADMax Core Summer Habitat	pH	Turbidity Nephelometric Turbidity Units (NTU)
	Standard	Extraordinary Contact				
North Creek	Geometric Mean	50	9.5	16	6.5 – 8.5	Shall not exceed 5 NTU over background when ≤ 50 or a 10 percent increase when background is > 50
	10 Percent not to Exceed	100				

Thornburgh (1996) showed that between 1992 and 1995, twenty-nine percent of County fecal coliform sample results at NCLD exceeded the extraordinary primary contact standard for North Creek. Standards require that not more than 10 percent of samples shall exceed the criteria of one hundred colonies / 100ml of sample.

Ecology is required by section 303d of the Clean Water Act to assess the status of waters and develop clean-up plans for those determined to be impaired beyond standards. Ecology acted upon the exceedences of the fecal coliform standard for North Creek at NCLD, and in 1998, listed the segment upstream of NCLD as impaired (Figure 1).

As further required by the Clean Water Act, Ecology developed a clean-up plan, otherwise referred to as a Total Maximum Daily Load (TMDL). for North Creek. The TMDL was supported by a water quality technical study using long-term monitoring data collected by the County at NCLD from May 1992 – May 1998.

The technical study authored by Glenn (2001), is titled North Creek Fecal Coliform Total Maximum Daily Load Submittal Report Publication 02-10-020, www.ecy.wa.gov/biblio/0103020.html. The TMDL's objective is to recommend to responsible stakeholders, such as the County and City, actions to assess and reduce discharges of fecal coliform bacteria to stormwater and/or receiving waters. These actions include, but are not limited to, water quality monitoring for trends analysis and source identification.

Ecology's assessments of the status of waters in 1998 and 2008 resulted in continuing the listing of impairment for the segment of North Creek upstream of NCLD (Figure 1). Ecology continues to work on the 2012 freshwater assessment, which will update the 2008 list.

In 2007, Ecology issued the National Pollution Discharge Elimination Systems (NPDES) Phase II Municipal Stormwater Permit to all small municipalities in Washington State, including Bothell. Appendix two of the permit required that Bothell develop a bacteria pollution control plan (BPCP) to address waterbodies, including North Creek, listed as impaired for fecal coliform bacteria. Bothell's BPCP is found at <http://www.ci.bothell.wa.us/Site/Content/Public%20Works/Surface%20Water%20Mgmt/FinalBPCPwithAppendix2011small.pdf>

The City's BPCP outlines a phased approach to achieve reductions in fecal coliform contamination observed in waterbodies. Phase three of the plan includes long term water quality monitoring of North Creek and targeted tributaries to describe trends and patterns of fecal coliform bacteria, assess potential exceedences of water quality standards, and utilize data to direct future source tracking surveys. The County's QAPP and the ILA support the City's

BPCP objectives and addresses requirements found in Appendix two of Bothell’s 2013 – 2018 NPDES permit.

Water Quality Monitoring

Consistent with the County’s Fecal Coliform TMDL Quality Assurance Project Plan (QAPP) (Britsch 2009), ILA and Cities BPCP, the County continued monthly water quality monitoring at NCLD through 2013. Sampling was carried out for parameters using field and lab analytical methods identified in table 2.

Table 2. 2012 Parameters Monitored at NCLD

Parameter	Instrument	Analytical Method
Fecal Coliform	NA	SM9222D
Total Suspended Solids	NA	SM2540B
Temperature	Hach Hydrolab	SM2550B-F
Dissolved Oxygen	Hach Hydrolab	SM4500OG
pH	Hach Hydrolab	EPA150.1M
Spec. Conductivity	Hach Hydrolab	EPA120.1M
Turbidity	Hach 2100P #1	EPA180.1

Data Analysis Methods

Ecology uses Water Quality Program Policy (WQP) 1-11 to describe methods of data analysis used for placing a waterbody on the 303d list as impaired, and generally describes the process for de-listing.

The WQP, updated July 2012, requires that analysis of geometric means and 10 percent not to exceed standards for fecal coliform bacteria data be upon seasons as established in TMDLs. A minimum of 10 samples must be obtained and analyzed by water year (WY), having five each from the wet and dry seasons. Determination of month ranges used for seasonal analysis in this report is driven by (Glen 2001), where Ecology assigned June 1 –October 30 the dry season and November 1 – May 30 to the wet season.

Given the July 2012 WQP update, the 2013 WY dry season months for fecal coliform bacteria analysis include and June – October 2013, whereas the wet season months include November – December 2012 and January – May 2013. All other parameters in this report are analyzed by calendar year, as the WQP does not require their analysis by WY.

It is of note that Ecology's approach to analysis of fecal coliform data using the 10 percent not to exceed standard is referred to the "raw scores" approach, whereby a stream segment is listed as impaired when greater than 10 percent of the measurements exceed the numeric criteria. Ecology (2002) recognized that use of the "raw scores" method for analysis of the 10 percent not to exceed standards results in an increased chance of type one and type two errors, where waterbodies are either listed as polluted when they should not be or not listed when they should be.

The County supports the State of Florida's approach for analysis of fecal coliform bacteria, whereby a minimum of the most recent thirty samples are analyzed using a binomial probability distribution at a ninety percent confidence interval to infer the true probability of impairment. This additional level of analysis is provided in the report.

Results and Discussion

Fecal Coliform Bacteria

Sufficient samples were gathered at NCLD during the 2013 WY to determine analyzed data as required by WAC 173-201A and the WQP. Fecal coliform bacteria results for the 2013 WY are found in table 3.

Dry Season Results

Dry season exceedences of the geometric mean and 10 percent not to exceed standard for fecal coliform bacteria standards were found at NCLD for the 2013 WY. The geometric mean was one hundred fourteen colonies /100ml while sixty percent of samples exceeded 100 colonies/100ml. Rain events likely contributed to exceedences of standards for at least two sample events during the 2013 dry season.

Wet Season Results

Wet season exceedences of the geometric mean and 10 percent not to exceed standard for fecal coliform bacteria standards were found at NCLD for the 2012 - 2013 WY. The geometric mean was fifty-nine colonies/100ml while twenty-nine percent of samples exceeded 100 colonies/100ml.

Combined Season Results

The combined season geometric mean of seventy-eight cfu/100ml exceeded the geometric mean standard. Forty-two percent of samples exceeded 100 colonies, causing this station to fail both parts of the standard for WY 2012-2013.

Table 3. WY 2013 Fecal Coliform Bacteria Results – NCLD

Sample Date	Weather	Water Color	Parameter	Sample Result (cfu/100ml)	Qualifier
2012-2013 Wet Season					
11/5/2012	Recent Rain	Tannic	Fecal Coliform	200	
12/3/2012	Recent Rain	Muddy	Fecal Coliform	140	
2/19/2013	Dry	Tannic	Fecal Coliform	38	
3/12/2013	Recent Rain	Tannic	Fecal Coliform	22	
4/4/2013	Rain	Tannic	Fecal Coliform	66	
5/1/2013	Dry	Tannic	Fecal Coliform	40	
			<i>Seasonal Geomean</i>	59	
			<i>% Samples Exceeding 100 Colonies/100ml</i>	29	
2013 Dry Season					
6/5/2013	Dry	Tannic	Fecal Coliform	38	
7/1/2013	Dry	Tannic	Fecal Coliform	120	
8/5/2013	Dry	Tannic	Fecal Coliform	85	
9/17/2013	Recent Rain	Tannic	Fecal Coliform	120	
10/1/2013	Recent Rain	Tannic	Fecal Coliform	420	
			<i>Seasonal Geomean</i>	114	
			<i>% Samples Exceeding 100 Colonies/100ml</i>	60	
2013 Combined Season					
			<i>Combined Season Geomean</i>	78	
			<i>% Samples Exceeding 100 Colonies/100ml</i>	42	

*Note: No qualified fecal coliform data for WY 2013

Ranking and Probability of Impairment

The County's Microbial Water Quality Assessment (MWQA) program analyzes a thirty sample dataset, using a binomial probability distribution, to assess the true probability of impairment.

A binomial probability distribution run on the most recent thirty samples (June 2011 – December 2013), using a ninety percent confidence interval, showed a ninety nine percent probability that > 10 percent of the combined season samples at NCLD truly exceed the criteria. This analysis provides statistically valid evidence of true impairment for the dataset under examination.

The same thirty sample dataset is also analyzed to determine the percent of samples exceeding 100 or 200 colonies / 100ml, depending upon the waterbody standard. The assigned rank dictates priority for contaminant source surveys to identify and eliminate sources of fecal coliform bacteria.

Over the last thirty sample dataset at NCLD, forty percent of combined season samples exceeded the extraordinary primary contract standard of 100 colonies / 100ml (Appendix B). When greater than thirty percent, but less than fifty percent of combined season samples exceed 100 colonies, the County assigns a site a MWQA rank of C, triggering prioritization for a contaminant source survey. A contaminant source survey is a phased approach utilizing GIS and field surveys upstream of the sample location to identify potential discharges to the receiving waters.

Total Suspended Solids

Measures of total suspended solids (TSS) are often associated with increased levels of water pollution. Table 4 summarizes TSS measurements at NCLD in 2013. Jolley et.al (2001) found strong correlation between TSS in receiving waters and fecal coliform bacteria concentrations, concluding that bottom sediments re-suspended by storm flow influence fecal coliform concentrations found in surface waters. A preliminary correlative analysis using 2010 data (n=9), for one location on Little Bear Creek found a high degree of correlation between fecal coliform bacteria and TSS ($r = .87$) (Britsch 2011). These data suggest that re-suspension of bottom sediments, polluted by external sources may also be a driver for exceedences of fecal coliform standards at NCLD.

Table 4. 2011 Total Suspended Solids at NCLD

Sample Date	Sample Time	Weather	Water Color	Sample Result (mg/l)	Qualifiers	Comment
1/22/2013	12:40	Dry	Tannic	5		
2/19/2013	12:55	Dry	Tannic	4		
3/12/2013	13:05	Recent Rain	Tannic	2		
4/4/2013	13:15	Rain	Tannic	3		
5/1/2013	13:20	Dry	Tannic	2		
6/5/2013	14:20	Dry	Tannic	5		
7/1/2013	13:40	Dry	Tannic	6		
8/5/2013	15:00	Dry	Tannic	4		
9/17/2013	12:40	Recent Rain	Tannic	5		
10/1/2013	13:10	Recent Rain	Tannic	10		
11/19/2013	10:25	Recent Rain	Muddy	15		
12/10/2013	11:00	Dry	Tannic	1		
Descriptive Statistics						
			Mean	5.1		
			Median	4.5		
			Minimum	1		
			Maximum	15		
			Standard Deviation	3.8		

Note: No TSS qualified in 2013.

Temperature

North Creek is designated as core summer salmonid habitat, requiring that the seven day average of the daily maximum (7Dadmax) stream temperature not exceed 16°C at a probability frequency of more than once every ten years on average. Where a seven day average of the daily maximum cannot be determined, the WQP allows use of single grab samples to determine whether numeric temperature criteria have been exceeded. Ecology may list a waterbody as a category 5 (impaired and requiring a TMDL) using single grab data when, (1) a minimum of three exceedences exist from all data considered, and (2) at least 10 percent of single grab values in a given year exceed the criteria.

Ecology's 2008 assessment resulted in listing this segment of North Creek (listing ID 7454 http://apps.ecy.wa.gov/wats/ViewListing.aspx?LISTING_ID=7454) as category 2 (waters of concern) for temperature. Ecology determined that unpublished County single grab sample data from 1998 was not sufficient for a category 5 listing of impairment. The County submitted 2011 grab sample data to Ecology, showing three consecutive exceedences of the standard during the summer critical period (twenty five percent of grab samples). This suggests that Ecology may list this segment as impaired during the 2012 fresh water assessment.

In 2013, stream grab samples temperatures at NCLD exceeded the core summer salmonid habitat criteria of 16°C during June, July and August (table 6). These exceedences in 2013, if evaluated alone, may justify determination of impairment according to the WQP.

Additionally, the County gathered high quality continuous temperature data at NCLD on 30 minute intervals in 2007 and 2008. The 2008 results produced a 7Dadmax of 18.80°C. The 7DadMax was exceeded for forty-four percent of the 2008 monitoring period. While this data has not been submitted to Ecology for assessment, it demonstrates previous exceedences of the standard in accordance with WAC 173-201A and the WQP.

Continuous temperature monitoring did not occur at NCLD. The City has deployed a continuous temperature logger in North Creek near its confluence with the Sammamish River.

Dissolved Oxygen

North Creek is not allowed to fall below a minimum one day dissolved oxygen value of 9.5 mg/l at an average frequency greater than once in ten years.

The WQP allows use of single event grab sample data collected infrequently for assessment of impairment. A waterbody will be placed in category 5 (impaired and requiring a TMDL) when (1) a minimum of three exceedences exist from all data considered, and (2) at least ten percent of single grab sample values in a given year do not meet the criteria.

Ecology's 2008 freshwater assessment resulted in listing this segment (listing ID 7457 http://apps.ecy.wa.gov/wats/ViewListing.aspx?LISTING_ID=7457) as category 5 (impaired) for dissolved oxygen. Ecology made this determination based upon data gathered by the City, Snohomish and King County's.

Where flow data exists, the WQP states that impairment may be determined using the 7 day consecutive low flow with a 10 year frequency (7Q10). That is, Ecology would list the segment as impaired when values are below the dissolved oxygen standard and flow is above the 7Q10. The exception is when a significant amount of data exists during the summer critical period showing compliance with the standard.

The County operated a flow gage at NCLD from May 1998 - May 2011, but calculation of the 7Q10 and comparison to dissolved oxygen values over the most recent 10 year period are outside the scope of this annual monitoring report.

The WQP does not allow single event grab sample data to make a determination of non-impairment, rather requires continuous dissolved oxygen data gathered at a minimum of 1 hour intervals during the critical period, generally June-September. A waterbody will be placed in TMDL category 1 (non-impaired) when data from the two most recent years, in which data exist, show no values below the standard.

As shown in table 6, dissolved oxygen values fell below 9.5 mg/l at NCLD in July of 2013. Over a ten year period (2004 – 2013), the County measured dissolved oxygen below 9.5 mg/l on eleven occasions, with 10 occurring during the critical summer period when flows would likely be at their lowest (Table 5). Six of the eleven values are estimated based upon deficient calibration records. It's unclear how Ecology would evaluate these estimated data during the assessment. Outside an evaluation of 7Q10 against individual dissolved oxygen results, Ecology may continue to list ID7457 as impaired for dissolved oxygen.

Table 5. NCLD Dissolved Oxygen Exceedences 2004 - 2013

Sample Date	Dissolved Oxygen mg/l	Season	Qualifier
8/3/2004	8.97	Dry	
9/8/2004	9.3	Dry	
9/7/2005	8.59	Dry	J
10/10/2006	9.4	Wet	
6/5/2007	8.38	Dry	J
7/5/2007	9.1	Dry	J
7/9/2008	9.42	Dry	J
9/8/2008	8.27	Dry	J
5/5/2009	8.06	Dry	J
8/10/2011	9.4	Dry	
7/1/2013	9.01	Dry	

Note: J flagged data viewed as estimates based upon deficient instrument calibration records

pH

Standards require that pH for North Creek not fall all outside the range of 6.5 and 8.5. The WQP accepts evaluation of single sample data from the most recent two years for which adequate data exist. Ecology’s 2008 freshwater assessment resulted in listing this segment (listing ID 51272 http://apps.ecy.wa.gov/wats/ViewListing.aspx?LISTING_ID=51272) as category 1, or meeting water quality standards. Single sample pH values at NCLD did not exceed standards during 2013 (table 6), nor did pH exceed standards in 2012. The data suggests that Ecology may continue to consider this segment as meeting standards for pH during the 2012 assessment.

Conductivity

Washington State does not have fresh water standards for conductivity. Measurements of conductivity or ionic strength can be used as a surrogate to identify levels of inorganic dissolved pollutants, including heavy metals. Generally speaking, waters in the County with lower levels of pollutants also exhibit annual average conductivities below 100 us/cm. The mean conductivity at NCLD in 2013 was 155.52 (table 6), much higher than the 2012 mean of 129.59 us/cm but similar to mean conductivities of 156.26 in us/cm in 2011.

Turbidity

Average or mean turbidities for 2013 were measured at 3.64 Nephelometric Turbidity Units (NTU) (table 6). These values could be considered annual background for comparison to water quality standards. As such, no other measurement during 2013 was greater than 5.0 NTU above this value.

Table 6. 2013 Insitu Results at NCLD

Sample Date	Sample Time	Weather	Water Color	Instrument Hydrolab	Temp. (Deg C)	Dissolved Oxygen (mg/l)	pH (units)	Cond. us/cm	Turbidity (NTU)	Qualifiers
1/22/2013	12:40	Rain	Tannic	Skipper	3.42	13.04	7.19	125.8	3.62	
2/19/2013	12:55	Dry	Tannic	Skipper	7.12	11.9	7.61	132.7	3.46	
3/12/2013	13:05	Dry	Tannic	Skipper	8.85	11.57	7.72	136.3	2.67	
4/4/2013	13:15	Recent Rain	Tannic	Skipper	10.49	11.48	7.94	152.4	2.67	
5/1/2013	13:20	Rain	Tannic	Lil' Buddy	10.99	11.51	7.63	155.9	1.95	
6/5/2013	14:20	Dry	Tannic	Lil' Buddy	17.41	10.08	7.72	196.4	4	
7/1/2013	13:40	Dry	Tannic	Lil' Buddy	20.5	9.01	7.51	193.2	3	
8/5/2013	15:00	Dry	Tannic	Skipper	19.08	9.5	8.45	202.9	2.96	
9/17/2013	12:40	Dry	Tannic	Skipper	14.84	9.88	7.59	179.9	2.47	
10/1/2013	13:10	Recent Rain	Tannic	Skipper	12.04	10.38	7.13	126.7	6.42	
11/19/2013	10:25	Recent Rain	Muddy	Skipper	9	10.97	6.96	110.5	7.83	
12/10/2013	11:00	Dry	Tannic	Skipper	2.34	13.68	6.99	153.6	2.65	
Descriptive Statistics				Mean	11.34	11.08	7.53	155.52	3.64	
				Median	10.99	11.22	7.6	153	2.98	
				Minimum	2.34	9.01	6.96	110.5	1.95	
				Maximum	20.5	13.68	8.45	202.9	7.83	
				Standard Deviation	5.77	1.4	0.42	31	1.74	

The County submits sample results to Ecology for storage in its' Environmental Information Management System (EIM). Data gathered at any County water quality monitoring station 2010 to present, including NCLD may be obtained at

<https://fortress.wa.gov/ecy/eimreporting/Detail.asp?Type=Study&ID=66789673&RecordsPerPage=100&RecordPage=1>

Data Quality Control

The primary purpose of establishing data quality objectives and reviewing data is to ensure that environmental programs produce datasets of known quality for decision making.

Data verification is the process of evaluating the completeness, correctness, and conformance of a specific dataset against the method, procedural, or contractual requirement. Data verification evaluates how closely the QAPP and established procedures or methods were followed (EPA 2002). Field activities and documentation, sample receipt, preparation, analysis and laboratory reports are typical records and processes evaluated during data verification. The County's TMDL Monitoring QAPP follows EPA (2002) and Mathieu (2006) guidelines for data verification and validation.

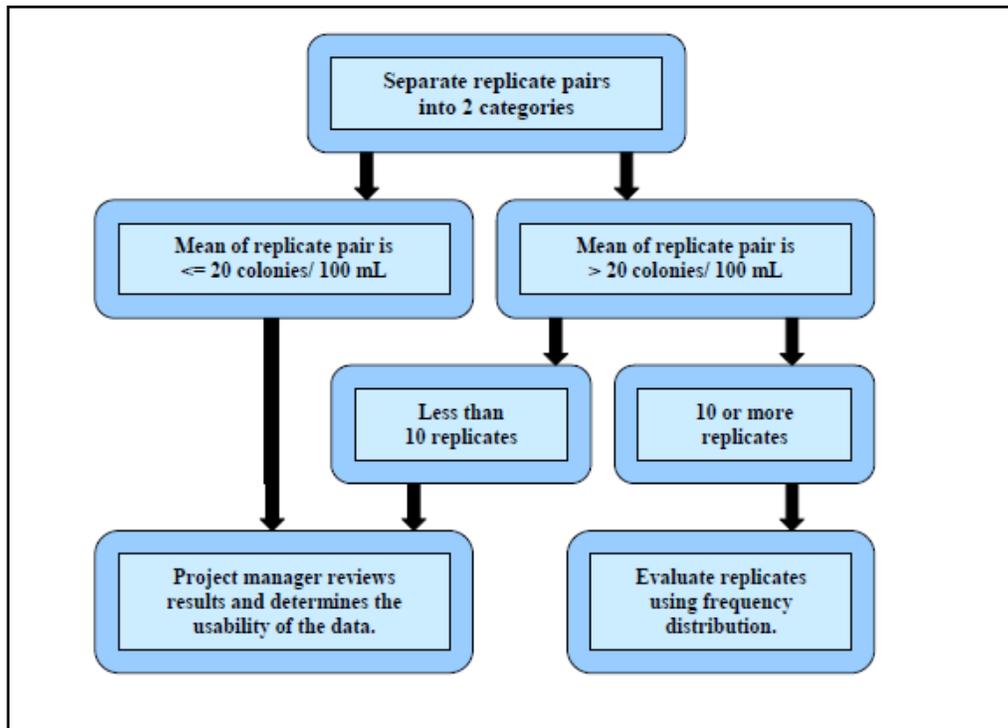
Field Sample and Measurement Quality Control

Samples were gathered and measurements taken at NCLD with one hundred percent completeness and without rejection during the 2013 monitoring period. The completeness goal for samples and measurements is set at seventy percent. Calibration standards were within expiration date. Field instruments pre and post monitoring calibrations were one hundred percent successful. One hundred percent of samples were kept at or below hold temperatures and analyzed within method specific hold times.

Field Duplicates

On an annual basis, the County randomly assigns sites where field duplicate sampling will occur. For CY 2013, NCLD was not assigned field duplicate samples. An evaluation of fecal coliform field duplicates is based upon forty-nine sets taken from other sampling sites across the County. The County adopted fecal coliform field duplicate data quality objectives as recommended by Mathieu (2006), where fifty percent of annual fecal coliform duplicate pairs where means are less than or equal to colonies, must exhibit less than twenty percent relative standard deviation (RSD). Additionally, ninety percent of the same duplicate results must be less than fifty percent different. The process for evaluating fecal coliform field duplicate samples is illustrated in figure 2.

Figure 2. Fecal Coliform Field Duplicate Evaluation Process (Mathieu 2006).



Where fecal coliform mean duplicate results are less than or equal to colonies, the ability to replicate results with precision as established in the QAPP has historically been poor. However, in 2013, fifty percent of duplicates where means where less than or equal to twenty colonies exhibited RSD's below 10 percent. This data quality objective was met for 2013.

However, ninety percent of duplicate pairs exhibited RSD's of greater than fifty percent, failing this data quality objective. Good precision at low levels indicates a high overall degree of precision.

Despite difficulties in meeting the ninety percent data quality objective for fecal coliform field duplicates, other measures of quality control such as field blanks, laboratory duplicate RPD's and lab method blanks were dominated by acceptable results. Overall, these data are considered acceptable for use.

Field Measurements

Prior to the beginning of each sample collection run, Hach – Hydrolab™ instruments used for the collection of in-stream measurements were calibrated for dissolved oxygen, conductivity and pH in accordance with manufacturers recommendations. Temperature sensor calibrations were conducted annually by the manufacturer. Post monitoring calibration checks are conducted to ensure sensor stability and verify measurement accuracy. Instrument calibrations

and checks are documented on hardcopy forms and kept with each instrument's calibration records. On an annual basis each instrument receives factory calibration and maintenance including software or firmware updates. Hach 2100P™ handheld turbidimeters are used to measure in-stream turbidity. Turbidimeters receive in-house quarterly primary calibrations and secondary calibration checks prior to each sample run in accordance with manufacturer's recommendations. Electronic records of calibrations are used to document the occurrence of calibrations, verify instrument performance, and determine if completeness goals are met.

All field measurements are verified usable without qualification for CY 2013.

Lab Quality Control

The County requests that lab duplicate analysis be performed on County samples where field duplicates are obtained. In the absence of this request, the contract lab runs lab quality control on other client samples. Lab duplicate analysis was not performed on samples from NCLD in 2013.

Findings and Recommendations

Water quality standards at NCLD during the 2013 monitoring period were exceeded for fecal coliform bacteria, temperature and dissolved oxygen. Interpretation of the WQP suggests that County flow and dissolved oxygen data could be evaluated further to assess impairment.

Exceedences of fecal coliform bacteria standards for WY 2013 were analyzed consistent with the WQP, indicating that Ecology would likely make the same determination.

The County analyzed the most current thirty fecal coliform sample dataset for assignment of a MWQA rank. The analysis shows that forty percent of combined season samples exceed the second part of the fecal coliform standard, i.e., 100 colonies / 100ml. When less than thirty but greater than fifty percent of fecal coliform samples exceed the second part of the criteria, i.e., 100 colonies / 100ml, the County recommends continued monitoring and prioritized phased contaminant source surveys.

Additionally, a binomial probability distribution, using a ninety percent confidence interval, was run on the most current thirty fecal coliform samples to assess the true probability of impairment. Results show a ninety-nine percent probability that > 10 percent of the combined season samples at NCLD exceed 100 cfu /100ml.

- An evaluation of flow to calculate the 7Q10 as compared to dissolved oxygen results over the last 10 year period is recommended to evaluate dissolved oxygen for attainment of standards per the WQP.

- Further, time series dissolved oxygen measurements as required by WQP1-11 would verify impairment or non-impairment
- Queensborough Creek is the largest tributary to North Creek within the City. In 2012, the County reported the potential for discharges of human waste to the Creek from spalling sewer standpipes and human encampments. To address ongoing fecal coliform impairments in North Creek, coordination with the sewer district to evaluate potential for sewer upsets or upgrades is recommended. Additionally, the City could consider source identification and elimination efforts in the basin.

Based upon results, the County recommends continue water quality monitoring at NCLD, and focused source identification and elimination efforts to isolate potential sources of fecal coliform in 2014.

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Appendix A

Agreement for Surface Water Management and Water Quality Services

**ORIGINAL
AGREEMENT**

between
Snohomish County
&
City of Bothell

**AGREEMENT FOR SURFACE WATER MANAGEMENT AND WATER QUALITY
SERVICES**

This AGREEMENT FOR SURFACE WATER MANAGEMENT AND WATER QUALITY SERVICES (this "Agreement") is made and entered into as of this 30th day of Dec., 2013 (the "Execution Date"), by and between the **CITY OF BOTHELL**, a Washington municipal corporation (the "City"), and **SNOHOMISH COUNTY**, a political subdivision of the State of Washington (the "County").

RECITALS

A. Due to the geography of the City and the County, storm and surface water often flows across and between the jurisdictional boundaries of the two entities. Thus, the City and the County share common interests with respect to certain water quality and quantity issues.

B. The City owns and operates a municipal separate storm sewer system subject to the requirements of the Western Washington Phase II Municipal Stormwater Permit (the "Phase II NPDES Permit") issued by the Washington Department of Ecology ("Ecology") pursuant to the National Pollutant Discharge Elimination System permit program established by the federal Clean Water Act, 33 U.S.C. § 1251 et seq., and the Washington State Waste Discharge permit program established by Washington's Water Pollution Control Law, Chapter 90.48 RCW.

C. The County owns and operates a municipal separate storm sewer system subject to the requirements of the Phase I Municipal Stormwater Permit (the "Phase I NPDES Permit") issued by Ecology pursuant to the National Pollutant Discharge Elimination System permit program established by the federal Clean Water Act, 33 U.S.C. § 1251 et seq., and the Washington State Waste Discharge permit program established by Washington's Water Pollution Control Law, Chapter 90.48 RCW.

D. The Phase II Permit requires the City to take certain actions related to water quality. The Phase I NPDES Permit imposes similar requirements on the County.

E. The City and the County are the parties to that certain Interlocal Agreement Between Snohomish County and the City of Bothell to Coordinate Surface Water Management Services Within the North and Swamp Creek Watershed Management Areas, dated March 13, 1996, and recorded under Snohomish County Auditor's File No. 9710070097 (the "1996 ILA"), which has been renewed on an annual basis through calendar year 2012.

F. The City now desires to hire the County to perform certain surface water quality monitoring and stream gaging related services for the City, and the County agrees to perform said services, all under the terms and conditions described in this Agreement.

G. The City and the County intend that this Agreement shall replace and supersede the 1996 ILA. Accordingly, upon full execution of this Agreement, the 1996 ILA shall immediately terminate and be of no further force or effect.

AGREEMENT

NOW, THEREFORE, in consideration of the respective agreements set forth below and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the City and the County agree as follows:

1. TERM

This Agreement is expressly intended to have retroactive effect. The term of this Agreement (the "Term") shall be deemed to have commenced on January 1, 2013 (the "Commencement Date"), and shall expire on December 31, 2018 (the "Expiration Date"); provided, however, that the County's obligations after December 31, 2013, are contingent upon local legislative appropriation of the necessary funds for this specific purpose in accordance with the Snohomish County Charter and applicable law.

2. CATEGORIES OF SERVICES PERFORMED BY COUNTY AND RIGHT OF ENTRY

During the Term of this Agreement, the County shall perform for the City the following services (collectively, the "Services"): (i) stream gage services, as more fully described in Section 3 below (the "Stream Gage Services"); (ii) surface water quality monitoring services, as more fully described in Section 4 below (the "Water Quality Monitoring Services"); and (iii) any additional services related to water quality issues that may be mutually agreed upon by the City and the County pursuant to Section 5 below (the "Additional Services"). The Services shall be performed in a good and professional manner, in accordance with both the substantive and procedural requirements specified in this Agreement.

The City shall provide the County with reasonable access to any location where Services are to be provided. If the City is unable to provide such access, the County shall have no obligation to perform any Services under this Agreement unless and until the City provides reasonable access.

3. STREAM GAGE SERVICES

3.1 Desired Flow Data

The City has established certain locations at which the City desires to monitor the water levels and other flow components of North Creek. As of the Execution Date of this Agreement, the City has installed a stream gage at 228th Street, SE for this purpose (the "Stream Gage").

3.2 Obtaining Stream Gage Data

The County shall visit the Stream Gage to obtain data from the Stream Gage on a regular basis, approximately every four (4) to six (6) weeks.

3.3 Delivering Stream Gage Data

The County currently makes data from the Stream Gage available to the City and the public on the following website (the "Website"):

http://test.snoco.org/app2/SPW/SPW_SWHydro/index.asp

During the Term of this Agreement, the County shall keep and maintain and continue to make available on the Website all historical data that is presently available on the Website (as of the Execution Date of this Agreement). As the County obtains new data from the Stream Gages, the County shall update the Website to make the newly obtained Stream Gage data available to the City and the public. The County shall use reasonable efforts to make new data available on the website within fourteen (14) days of obtaining the new data. At any time and from time to time during the Term of this Agreement, the County and the City may agree to use: (i) a different website location for posting the Stream Gage data; and/or (ii) an entirely different method of delivering the Stream Gage data to the City.

3.4 Maintenance and Repair of Stream Gage

The Stream Gage is the personal property of the City. Except to the extent that any damage to the Stream Gage is caused by the County, all responsibility for maintenance and repair of the Stream Gage rests with the City. The County currently undertakes regular Stream Gage maintenance and repair activities at the request of the City. During the Term of this Agreement, the County shall continue providing regular Stream Gage maintenance and repair activities for the City. Should the County notice, during any visit to the Stream Gage, that the Stream Gage is in need of repair or maintenance, the County shall promptly notify the City of the need for repair or maintenance and shall perform such repair or maintenance at the request of the City.

4. WATER QUALITY MONITORING SERVICES

4.1 Monitoring Site

There is a surface water quality monitoring site (the "Monitoring Site") located in the North Creek watershed within the City boundaries at 240th Street SE. This Monitoring Site, also known as the NCLD monitoring site, was established based upon known impairments for fecal coliform bacteria at that location on North Creek. Continued monitoring at the Monitoring Site is an important part of the City's compliance with its Phase II NPDES Permit which requires the City to implement routine water quality monitoring and source identification to address waterbodies, including North Creek, listed by Ecology as being impaired for fecal coliform bacteria.

4.2 Desired Water Quality Data

As of the Execution Date of this Agreement, the water quality parameters the City desires to study at the Monitoring site include field measurements for: (i) temperature; (ii) dissolved oxygen; (iii) pH; (iv) conductivity; (v) turbidity; (vi) total suspended solids; and (vii) fecal coliform bacteria.

4.3 Obtaining Water Quality Data

As access, weather, and resources allow, the County will conduct monthly water quality monitoring, using grab sample methods, at the Monitoring Site as discussed in the County's Quality Assurance Project Plan ("QAPP"). Within resource capacity and upon request, the County will conduct contaminant source surveys and bacteria source tracking to identify potential sources of fecal coliform bacteria.

Quality control activities to ensure credibility of data, as described in the QAPP, will include but are not limited to: (i) calibration and maintenance of field instruments; (ii) collection of field quality control samples; and (iii) verification of laboratory and field data for comparison to data quality objectives.

The County shall promptly deliver necessary samples to an Ecology accredited laboratory for analysis. The laboratory results are sent to the County in electronic and hardcopy format. The County shall provide a copy of such results to the City promptly upon the City's request.

4.4 Delivering Water Quality Data

The County shall compile the water quality data provided through lab services and collected from field measurements at the Monitoring Site, verify it for usability, and make it available to the City and general public through Ecology's Environmental Information Management (EIM) System website:

<https://fortress.wa.gov/ecy/eimreporting/Detail/Detail.aspx?DetailType=Study&SystemStudyId=66789673>

During the Term of this Agreement, and to the extent allowed by laboratory contracts and State budgetary priorities to maintain EIM, the County shall continue to make available on the Website all historical data that is presently available on the Website (as of the Execution Date of this Agreement). As the County obtains new data, the County shall update the Website to make the newly obtained water quality data available to the City and the public. The County shall use reasonable efforts to make new data available on the website within three (3) months of obtaining and verifying data for usability.

The County will deliver a water quality monitoring report to the City once per calendar year. The report for a given calendar year shall be delivered to the City on or before February 15 after the close of the calendar year at issue.

5. ADDITIONAL SERVICES

5.1 Additional Services May Be Desired

The County and the City anticipate that, during the Term of this Agreement, the City may desire for the County to provide additional surface water quality or stream gaging related services (the "Additional Services") to the City, and the County may be willing to provide some or all of such Additional Services. By way of example, and not by way of limitation, the parties anticipate Additional Services could involve any one or more of the following: (i) installation of one or more new stream gages or otherwise establishing new sites at which water levels and/or other flow components of North Creek and/or its tributaries would be measured; (ii) establishment one or more new surface water quality monitoring sites for North Creek and/or its tributaries; (iii) sampling one or more water quality monitoring sites for additional or different water quality parameters; or (iv) commencement of other activities that enhance the City's water quality program.

5.2 Requesting Additional Services

Subject to the total cost limitation described in Section 5.4 below, at any time and from time to time during the Term of this Agreement, the City may request that the County perform one or more Additional Services. The City may request that such Additional Services be performed a specific number of times, or on an ongoing basis, for a single calendar year, or for multiple calendar years. The County may, but need not, agree to perform some or all of the requested Additional Services under terms and conditions acceptable to both parties. Any agreement to add Additional Services must be memorialized in writing and signed by the City's Director and the County's Director (as those terms are defined in Section 5.3 below).

5.3 Authority to Request and Approve Additional Services

Subject to the total cost limitation described in Section 5.4 below, the Director of the City's Department of Public Works (the "City's Director") shall have the authority to request, authorize and memorialize Additional Services on behalf of the City without the need to obtain additional approvals from the City Council or the Mayor. Subject to the total cost limitation described in Section 5.4 below, the Director of the County's Department of Public Works (the "County's Director") shall have the authority to agree to perform and memorialize Additional Services on behalf of the County without the need to obtain additional approvals from the County Executive.

5.4 Total Services Not to Exceed \$50,000 Maximum Cost

Notwithstanding anything to the contrary contained elsewhere in this Agreement, the total cumulative cost of all Services performed by the County under this Agreement shall not exceed Fifty Thousand and No/100 Dollars (\$50,000.00) (the "Maximum Cost"). Accordingly, if any proposal to add one or more Additional Services to this Agreement would cause the total cost of Services to exceed the Maximum Cost, the City shall not submit

a request for such Additional Services to the County. Should the County receive a request for Additional Services that would cause the total cost of all Services to exceed the Maximum Cost, the County shall reject said request.

6. COMPENSATION

6.1 Time and Materials

The County shall be compensated for its Services on a time and materials basis. The County's time shall be calculated based on the base hourly rate of each of the individual County Personnel (as that term is defined in Section 7 below) performing the Services. The actual reasonable cost of benefits shall be added to the base hourly rate of all County Personnel. The time billed to the City shall consist only of personnel time that is actually spent and is reasonably required to perform the Services. The City shall reimburse the County for all reasonable costs actually incurred by the County in connection with performing the Services, including, but not limited to, laboratory fees and an agreed upon 15% contract administration fee on any labor costs (wages, benefits, and applied leave). The City shall reimburse the County for the reasonable costs of materials and/or equipment the County uses in connection with performing any one or more of the Services.

On or before November 1st of each year the County shall provide the City with a written estimate for the total cost of performing the Services for the following calendar year. The City must provide written acceptance of the cost estimate to the County on or before December 1st of the year that the County's cost estimate is provided. This Agreement shall terminate on December 31st of the year that the County's cost estimate is provided to the City if either: (1) the City does not provide written acceptance of the County's cost estimate as required in this Section 6.1; or (2) the City rejects the County's cost estimate.

6.2 Invoicing and Payment

The County shall submit quarterly invoices to the City. Each quarterly invoice shall describe in reasonable detail the amount of time spent by the County on which Services during the fiscal quarter at issue. Reimbursable cost items and the cost of any materials and/or equipment used by the County in performing said services shall also be itemized on the quarterly invoice. The City shall pay each quarterly invoice within thirty (30) days of receiving same. Invoices shall be sent to the following address:

City of Bothell
Department of Public Works
18305 – 101st Avenue NE
Bothell, WA 98011
Attn: Andy Loch

6.3 Retroactive Invoicing and Payment

As of the Execution Date, the County has provided Services to the City for which it has not been compensated. The County may retroactively invoice the City for any Services performed after the Commencement Date and before the Execution Date of this Agreement. Such invoice shall describe in reasonable detail the amount of time spent by the County on which Services after the Commencement Date and before the Execution Date and shall include a 15% contract administrative fee on any labor costs (wages, benefits, and applied leave). Reimbursable cost items and the cost of any materials and/or equipment used by the County in performing said services shall also be itemized on the retroactive invoice. The City shall pay the retroactive invoice within thirty (30) days of receiving same.

7. INDEPENDENT CONTRACTOR

All work performed by the County pursuant to this Agreement shall be performed by the County as an independent contractor and not as an agent or employee of the City. The County shall furnish, employ, and have exclusive control of all persons to be engaged in performing the County's obligations under this Agreement (collectively, the "County Personnel") and shall prescribe and control the means and methods of performing such obligations by providing adequate and proper supervision. The County Personnel shall for all purposes be solely the employees or agents of the County and shall not be deemed to be employees or agents of the City for any purpose whatsoever. With respect to the County Personnel, the County shall be solely responsible for compliance with all rules, laws, and regulations relating to employment of labor, hours of labor, working conditions, payment of wages and payment of taxes, such as employment, Social Security, and other payroll taxes including applicable contributions from the County Personnel when required by law.

8. TERMINATION FOR CONVENIENCE

This Agreement may be terminated by either party for any reason or for no reason, by giving thirty (30) days advance written notice of termination to the other party. Any termination notice delivered pursuant to this Section 8 shall specify the date on which the Agreement will terminate. If this Agreement is terminated pursuant to this Section 8, the County shall continue performing Services through the date of termination. The City shall compensate the County for all Services performed by the County through the date of termination. The City's obligation to make such final payment to the County shall survive the termination of this Agreement.

9. COMPLIANCE WITH LAWS

The City and the County shall at all times exercise their rights and perform their respective obligations under this Agreement in full compliance with all applicable laws, ordinances, rules and regulations of any public authority having jurisdiction.

10. INDEMNIFICATION

Each party to this Agreement shall indemnify, defend and hold the other party and its agents, employees and contractors harmless from and against any and all costs, liabilities, suits, losses, damages, claims, expenses, penalties or charges, including, without limitation, reasonable attorneys' fees and disbursements, that the other party may incur or pay out by reason of: (i) any accidents, damages or injuries to persons or property occurring during the Term of this Agreement, but only to the extent the same are caused by any negligent or wrongful act of the indemnifying party; or (ii) any breach or Default (as such term is defined in Section 11 below) of the indemnifying party under this Agreement. The provisions of this Section 10 shall survive the expiration or earlier termination of this Agreement.

11. DEFAULT AND REMEDIES

If either party to this Agreement fails to perform any act or obligation required to be performed by it hereunder, the party to whom such performance was due shall deliver written notice of such failure to the non-performing party. The non-performing party shall have thirty (30) days after its receipt of such notice in which to correct its failure to perform the act or obligation at issue, after which time it shall be in default ("Default") under this Agreement; provided, however, that if the non-performance is of a type that could not reasonably be cured within said thirty (30) day period, then the non-performing party shall not be in Default if it commences cure within said thirty (30) day period and thereafter diligently pursues cure to completion. In the event of a party's Default under this Agreement, then after giving notice and an opportunity to cure, the party to whom the performance was due shall have the right to exercise any or all rights and remedies available to it at law or in equity.

12. PUBLIC DISCLOSURE LAWS

The City and the County each acknowledges, agrees and understands that the other party is a public agency subject to certain disclosure laws, including, but not limited to Washington's Public Records Act, chapter 42.56 RCW. Each party understands that records related to this Agreement and the County's performance of Services under this Agreement may be subject to disclosure pursuant to the Public Records Act or other similar law. Neither the City nor the County anticipates that the performance of either party's obligations under this Agreement will involve any confidential or proprietary information.

13. NOTICES

Each notice, demand, request, consent, approval, disapproval, designation or other communication that is permitted or required to be given by one party to the other party under this Agreement shall be in writing and shall be given or made or communicated by: (i) United States registered or certified mail, postage prepaid, return receipt requested; (ii) any nationally recognized overnight carrier or express mail service (such as FedEx or DHL) that provides receipts to indicate delivery; (iii) by personal delivery; or (iv) by

facsimile (with proof of successful transmission). All such communications shall be addressed as follows:

To the City:

ATTN: Andy Loch
City of Bothell
Department of Public Works
18305 101st Avenue NE
Bothell, WA 98011
Telephone: (425) 486-2768
Facsimile: _____
Email: Andy.Loch@ci.bothell.wa.us

To the County:

ATTN: Lauren Tracy
Snohomish County
Department of Public Works
Surface Water Management Division
3000 Rockefeller Avenue M/S 607
Everett, Washington 98201
Telephone: (425) 388-3253
Facsimile: (425) 388-6455
Email: Lauren.Tracy@snoco.org

All notices shall be deemed given on the day each such notice is personally delivered, transmitted by facsimile (with evidence of receipt), or delivered by overnight courier service, or on the third business day following the day such notice is mailed if mailed in accordance with this Section.

14. MISCELLANEOUS

14.1 Entire Agreement

This Agreement constitutes the entire agreement between the parties regarding the subject matter hereof, and supersedes any and all prior oral or written agreements between the parties regarding the subject matter contained herein. This Agreement may not be modified or amended in any manner except by a written document signed by the party against whom such modification is sought to be enforced.

14.2 Interpretation

This Agreement shall be governed by and enforced in accordance with the laws of the State of Washington. This Agreement and each of the terms and provisions of it are deemed to have been explicitly negotiated by the parties, and the language in all parts of this Agreement shall, in all cases, be construed according to its fair meaning and not strictly for or against either of the parties hereto. The captions and headings in this Agreement are used only for convenience and are not intended to affect the interpretation of the provisions of this Agreement. This Agreement shall be construed so that wherever applicable the use of the singular number shall include the plural number, and vice versa, and the use of any gender shall be applicable to all genders.

14.3 Severability

If any provision of this Agreement or the application thereof to any person or circumstance shall, for any reason and to any extent, be found invalid or unenforceable, the remainder of this Agreement and the application of that provision to other persons or

circumstances shall not be affected thereby, but shall instead continue in full force and effect, to the extent permitted by law.

14.4 No Waiver

A party's forbearance or delay in exercising any right or remedy with respect to a Default by the other party under this Agreement shall not constitute a waiver of the Default at issue. Nor shall a waiver by a party of any particular Default constitute a waiver of any other Default or any similar future Default.

14.5 Assignment

This Agreement shall not be assigned, either in whole or in part, by either of the parties hereto. Any attempt to assign this Agreement in violation of the preceding sentence shall be null and void and shall constitute a Default under this Agreement.

14.6 Warranty of Authority

Each of the signatories hereto warrants and represents that he or she is competent and authorized to enter into this Agreement on behalf of the party for whom he or she purports to sign this Agreement.

14.7 No Joint Venture

Nothing contained in this Agreement shall be construed as creating any type or manner of partnership, joint venture or other joint enterprise between the parties.

14.8 No Third Party Beneficiaries

This Agreement is made and entered into for the sole benefit of the City and the County. No third party shall be deemed to have any rights under this Agreement; there are no third party beneficiaries to this Agreement.

14.9 Execution in Counterparts

This Agreement may be executed in two or more counterparts, each of which shall constitute an original and all of which shall constitute one and the same agreement.

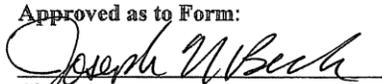
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IN WITNESS WHEREOF, the City and the County have executed this Agreement as of the date first above written.

THE CITY:

City of Bothell, a Washington municipal corporation

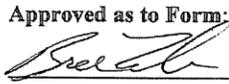
By 
Name: STEPHEN L. ANDERSON
Title: DEPUTY CITY MANAGER

Approved as to Form:

City Attorney

THE COUNTY:

Snohomish County, a political subdivision of the State of Washington

By  12/30/13
Name: _____
Title: PETER B. CAMP
Executive Director

Approved as to Form:
 November 21, 2013
Deputy Prosecuting Attorney

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Appendix B

NCLD - Fecal Coliform Bacteria Data Analysis over Last 30 Samples

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Date	Season	Fecal coliform bacteria (col/100ml)	Data Qualifier	Combined		Wet		10 % Not to Exceed	Standard	Combined	Count		Count Dry	% Dry	Count Wet	% Wet	MWQA
				Season Geomean	Dry Season GeoMean	Season Geomean	Standard				Season Count	Samples >100 Colonies					
6/1/2011	dry	190	None	84	125	56	50	100	30	12	40	15	8	53	15	4	27 C
7/5/2011	dry	76	None														
8/10/2011	dry	340	None														
9/19/2011	dry	150	None														
10/12/2011	dry	58	None														
6/13/2012	dry	1800															
7/11/2012	dry	120	Laboratory Duplicate RPD exceeds acceptance limits; sample result is an estimate														
8/14/2012	dry	54															
9/5/2012	dry	44															
10/3/2012	dry	66															
6/5/2013	dry	38	None														
7/1/2013	dry	120	None														
8/5/2013	dry	85	None														
9/17/2013	dry	120	None														
10/1/2013	dry	420	None														
11/2/2011	wet	28	Laboratory Duplicate RPD exceeds acceptance limits; sample result is an estimate														
12/6/2011	wet	14	None														
2/21/2012	wet	380	None														
3/6/2012	wet	74	None														
4/2/2012	wet	8	None														
5/2/2012	wet	96	None														
11/5/2012	wet	200	None														
12/3/2012	wet	140	None														
1/22/2013	wet	42	None														
2/19/2013	wet	38	None														
3/12/2013	wet	22	None														
4/4/2013	wet	66	None														
5/1/2013	wet	40	None														
11/19/2013	wet	190	None														
12/10/2013	wet	40	None														