



Ministry of  
Environment

**Oyster River  
Vancouver Island  
Water Quality Objectives Attainment Report  
2001-2008**

Environmental Quality Section  
Environmental Protection Division  
Vancouver Island Region

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## **Executive Summary**

This report summarizes the findings of the 2001-2008 water quality attainment monitoring of the Oyster River watershed, located southwest of Campbell River on Vancouver Island, British Columbia. The sampling program was based on the Oyster River water quality objectives report (Nagpal, 1990). At that time, forestry was the main land use activity in the watershed, and there was concern that proposed mining developments would impact water quality in the future. To date, no mining has occurred in the watershed. In the upper watershed, forestry continues to be the main land use activity; however, rural residential development and agriculture are the main land use activities in the lower watershed.

Most parameters were well below the water quality objectives. Non-filterable residue and turbidity were elevated and exceeded the objective in the Oyster River mainstem. Aluminum was elevated above the objectives in the tributaries, Woodhus Creek and Little Oyster River, and in the Oyster River downstream of the confluence. Cadmium and chromium exceeded the objective in the Little Oyster River on one occasion. Fecal coliform objectives were exceeded in the Oyster River mainstem on one occasion. Fecal coliform levels in Little Oyster River were higher than at other sites, though no fecal coliform objective exists for this stream. pH exceeded the objective on one occasion in the Oyster River mainstem. Most objective exceedances occurred during fall high flow periods, with the exception of fecal coliform, cadmium and chromium exceedances, which occurred during summer low flow periods.

Recommendations include modifying the iron objectives for some sites, and removing references in the objectives report to sampling lead and mercury in fish tissue.

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## Introduction

As part of the Province of British Columbia, Ministry of Environment's (MoE) mandate to manage water bodies, water quality objective reports have been created for a number of lakes, rivers and marine surface waters. These reports provide a list of objectives to protect water quality, tailored to the specific water body for which they have been created. This takes into account natural local water quality, water uses, water movement, and waste discharges. While the water quality objectives currently have no legal standing, they can direct resource managers aiming to protect the water body in question and are used as a standard against which to measure the water quality of a particular lake or river. Once objectives have been developed, periodic monitoring (every three to five years) is undertaken to determine whether they are being met. While attainment monitoring has been ongoing in the Vancouver Island region, a need has been identified for more detailed attainment reporting.

The Vancouver Island region has adopted an ecoregion approach to developing water quality objectives. The Vancouver Island ecoregions are based on the ecosections developed by Demarchi (1995) (Deniseger *et al.* 2009). This approach operates under the premise that lakes and rivers within an ecoregion will be more similar to each other than to lakes and rivers in other ecoregions. As a result, water quality objectives for one watershed can be applied, on an interim basis, to another watershed without objectives within the same ecoregion. The Oyster River watershed is in the Leeward Island Mountains and Nanaimo Lowland ecoregions (See Appendix – Figure 1).

In 1988, the MoE developed a Water Management Plan for the Oyster River watershed. This plan identified several water quality concerns in the watershed in light of potential future land uses, and in 1990 a Water Quality Objectives report was produced (see Nagpal, 1990). The report summarized results from multiple monitoring stations, and proposed objectives for four sites. Some sampling was conducted from 1990 to 1999, and focused objective attainment monitoring was conducted in 2001, 2002, 2003 and 2008. The 2001, 2002 and 2003 data were summarized briefly in provincial attainment monitoring reports. This report provides a more thorough assessment of the attainment monitoring from 2001 to 2008.

Land use in the Oyster River watershed has not changed significantly since the objectives were developed. Forestry is still the dominant activity in the upper watershed, and forest harvesting has increased in Woodhus Creek and Little Oyster River watersheds. Agricultural and rural residential land use occurs in the lower watershed. None of the potential mining sites have been developed. A sewage treatment plant discharges effluent from the Mt. Washington ski resort into Piggott Creek, a tributary to the Oyster River. It was upgraded in the late 1990s to include an advanced tertiary treatment system with ultraviolet disinfection. There are still

multiple water withdrawals from the lower reaches of the Oyster River, some of which are for domestic supply. Water treatment varies among the withdrawals.

### **Sampling and Analytical Methods**

For attainment monitoring, two sites on the Oyster River mainstem were monitored in the fall of 2001. These sites were Oyster River at Logging Road Bridge (Duncan Main) (Site 1) and Oyster River at Highway 1 (Site 2) (Table 1). In 2002, 2003 and 2008 summer and fall monitoring was conducted at both of these sites, as well as in Woodhus Creek (Site 3) and Little Oyster River (Site 4) (See Appendix - Figure 2). For each sampling period, five weekly water samples were collected over 30 days (5-in-30 sampling) to calculate 30-day averages and 90<sup>th</sup> percentiles, as recommended in the water quality objectives report.

Sampling varied slightly between years. In 2001, the only parameters measured were fecal coliforms, nitrogen (nitrate, nitrate plus nitrite, and nitrite), suspended solids and pH. Nitrite, iron and hardness were not measured in 2002 and 2003. Iron was measured only in 2008. Mercury was not measured in any year.

Minimum, maximum, mean and standard deviation values were calculated for each 5-in-30 sampling period. The objectives are listed in Table 2. The data are summarized in the Appendix in Table 12- Table 15, and the raw data are included in Table 16-Table 19.

**Table 1. Oyster River Site Names, Site Numbers, EMS IDs and Descriptions.**

<b>Site Name</b>	<b>Site Number</b>	<b>EMS ID</b>	<b>Description</b>
Oyster River at Logging Road Bridge (Duncan Main)	Site 1	0125582	Mainstem Oyster River upstream of Woodhus Creek and Little Oyster River confluences
Oyster River at Highway 1	Site 2	0125580	Mainstem Oyster River downstream of Woodhus Creek and Little Oyster River confluences
Woodhus Creek at Duncan Main	Site 3	E207431	Site located at bridge crossing on York Road
Little Oyster River at York Road	Site 4	E207430	Site located at bridge crossing at Duncan Mainline Road near York Road



## Objectives Attainment

A summary of the objectives for the Oyster River watershed are provided in Table 2.

**Table 2. Water Quality Objectives for the Oyster River Watershed (from Nagpal, 1990b).**

	Oyster River u/s Woodhus Creek and Little Oyster River	Oyster River d/s Woodhus Creek and Little Oyster River	Woodhus Creek	Little Oyster River
	Site 1	Site 2	Site 3	Site 4
Residue Non- filterable (mg/L)	≤12 mg/L (max)	≤15mg/L (90th percentile)		none proposed
Turbidity (NTU)	≤5 NTU (max)	≤7 NTU (90th percentile)		none proposed
Ammonia:T (mg/L)	see table in Nagpal, 1990a	see table in Nagpal, 1990a	see table in Nagpal, 1990a	see table in Nagpal, 1990a
Nitrogen - Nitrite Diss. (mg/L)	≤0.02 mg/L (mean); 0.06 mg/L (max)			
Nitrate + Nitrite Diss. (mg/L)	≤10mg/L (max)			
Coli:Fec (CFU/100mL)	≤100 CFU/100 mL (90th percentile)		none proposed, limited data	
Al-D (mg/L)	≤0.05 mg/L (mean); 0.1 mg/L (max)			
As-T (mg/L)	≤0.05 mg/L (max)			
Cd-T (µg/L)	≤0.2 µg/L (max)			
Cr-T (µg/L)	≤2 µg/L (max)			
Co-T (µg/L)	≤50 µg/L (max)			
Cu-T (µg/L)	≤3 µg/L (mean); ≤5 µg/L (90th percentile)		≤10 µg/L (90th percentile)	
Fe-D (mg/L)	≤0.3 mg/L (90th percentile)		none proposed; naturally high levels	
Pb-T (mg/L)	$3.31 + e^{(1.273 \ln(\text{av. hardness}) - 4.705)}$ µg/L (mean); $e^{(1.273 \ln(\text{hardness}) - 1.46)}$ µg/L (max); 0.8 µg/g wet weight in edible portion of fish (max)			
Mn-D (mg/L)	≤0.05 mg/L (max)			none proposed; naturally high levels
Hg (µg/L)	≤0.02 µg/L (mean); ≤0.1 µg/L (max); ≤0.5 mg/kg in fish (max)			
Ni-T (mg/L)	≤0.025 mg/L (max)			
Zn-T (mg/L)	≤0.01 mg/L (mean); ≤0.03 mg/L (max)			
pH (pH units)	≥6.5 (min); ≤8.5 (max)	≥6.5 (95th percentile); ≤8.5 (max)	≥6.5 (min); ≤8.5 (max)	

A summary of objectives attainment results are provided in Table 3, Table 4, Table 5, and Table 6.

**Table 3. Objective Attainment Results for 2001.**

	Site 1		Site 2		Site 3		Site 4	
	summer	fall	summer	fall	summer	fall	summer	fall
Residue Non-filterable (mg/L)	y	y	y	n	—	—	n/a	n/a
Turbidity (NTU)	y	1	y	n	—	—	n/a	n/a
Ammonia:T (mg/L)	y	y	y	y	—	—	—	—
Nitrite Diss. (mg/L) - mean	y	y	y	y	—	—	—	—
Nitrite Diss. (mg/L) - max	y	y	y	y	—	—	—	—
Nitrate + Nitrite Diss. (mg/L)	y	y	y	y	—	—	—	—
Coli:Fec (CFU/100mL)	y	y	y	y	n/a	n/a	n/a	n/a
Al-D (mg/L) - mean	y	y	y	y	—	—	—	—
Al-D (mg/L) - max	y	y	y	y	—	—	—	—
As-T (mg/L)	y	y	y	y	—	—	—	—
Cd-T (µg/L)	y	y	y	y	—	—	—	—
Cr-T (µg/L)	y	y	y	y	—	—	—	—
Co-T (µg/L)	y	y	y	y	—	—	—	—
Cu-T (mg/L) - mean	y	y	y	y	—	—	—	—
Cu-T (mg/L) - 90 <sup>th</sup> perc.	y	y	y	y	—	—	—	—
Mn-D (mg/L)	y	y	y	y	—	—	n/a	n/a
Pb-T (mg/L) - mean	y	y	y	y	—	—	—	—
Pb-T (mg/L) - max	y	y	y	y	—	—	—	—
Hg (µg/L)	—	—	—	—	—	—	—	—
Ni-T (mg/L)	y	y	y	y	—	—	—	—
Zn-T (mg/L) - mean	y	y	y	y	—	—	—	—
Zn-T (mg/L) - max	y	y	y	y	—	—	—	—
pH (pH units)	y	y	y	y	—	—	—	—

"y" indicates objective met

"n" indicates objective exceeded; if applicable, the number of samples that exceeded the objective is shown

"—" indicates no data for that sampling period

**Table 4. Objective Attainment Results for 2002.**

	Site 1		Site 2		Site 3		Site 4	
	summer	fall	summer	fall	summer	fall	summer	fall
<b>Residue Non-filterable (mg/L)</b>	y	y	y	y	y	y	y	y
<b>Turbidity (NTU)</b>	y	y	y	y	y	y	y	y
<b>Ammonia:T (mg/L)</b>	y	y	y	y	y	y	y	y
<b>Nitrite Diss. (mg/L) - mean</b>	y	y	y	y	y	y	y	y
<b>Nitrite Diss. (mg/L) - max</b>	y	y	y	y	y	y	y	y
<b>Nitrate + Nitrite Diss. (mg/L)</b>	y	y	y	y	y	y	y	y
<b>Coli:Fec (CFU/100mL)</b>	y	y	y	y	n/a	n/a	n/a	n/a
<b>Al-D (mg/L) - mean</b>	y	y	y	n	y	n	y	n
<b>Al-D (mg/L) - max</b>	y	y	y	1	y	2	y	2
<b>As-T (mg/L)</b>	y	y	y	y	y	y	y	y
<b>Cd-T (µg/L)</b>	y	y	y	y	y	y	y	y
<b>Cr-T (µg/L)</b>	y	y	y	y	y	y	y	y
<b>Co-T (µg/L)</b>	y	y	y	y	y	y	y	y
<b>Cu-T (mg/L) - mean</b>	y	y	y	y	y	y	y	y
<b>Cu-T (mg/L) - 90<sup>th</sup> perc.</b>	y	y	y	y	y	y	y	y
<b>Mn-D (mg/L)</b>	y	y	y	y	y	y	n/a	n/a
<b>Pb-T (mg/L) - mean</b>	y	y	y	y	y	y	y	y
<b>Pb-T (mg/L) - max</b>	y	y	y	y	y	y	y	y
<b>Hg (µg/L)</b>	—	—	—	—	—	—	—	—
<b>Ni-T (mg/L)</b>	y	y	y	y	y	y	y	y
<b>Zn-T (mg/L) - mean</b>	y	y	y	y	y	y	y	y
<b>Zn-T (mg/L) - max</b>	y	y	y	y	y	y	y	y
<b>pH (pH units)</b>	y	y	y	1	y	y	y	y

"y" indicates objective met

"n" indicates objective exceeded; if applicable, the number of samples that exceeded the objective is shown

"—" indicates no data for that sampling period

**Table 5. Objective Attainment Results for 2003.**

	Site 1		Site 2		Site 3		Site 4	
	summer	fall	summer	fall	summer	fall	summer	fall
<b>Residue Non-filterable (mg/L)</b>	y	1	y	n	y	y	n/a	n/a
<b>Turbidity (NTU)</b>	y	1	y	n	y	y	n/a	n/a
<b>Ammonia:T (mg/L)</b>	y	y	y	y	y	y	y	y
<b>Nitrite Diss. (mg/L) - mean</b>	y	y	y	y	y	y	y	y
<b>Nitrite Diss. (mg/L) - max</b>	y	y	y	y	y	y	y	y
<b>Nitrate + Nitrite Diss. (mg/L)</b>	y	y	y	y	y	y	y	y
<b>Coli:Fec (CFU/100mL)</b>	n	y	y	y	n/a	n/a	n/a	n/a
<b>Al-D (mg/L) - mean</b>	y	y	y	y	y	n	y	n
<b>Al-D (mg/L) - max</b>	y	y	y	y	y	1	y	4
<b>As-T (mg/L)</b>	y	y	y	y	y	y	y	y
<b>Cd-T (µg/L)</b>	y	y	y	y	y	y	1	y
<b>Cr-T (µg/L)</b>	y	y	y	y	y	y	1	y
<b>Co-T (µg/L)</b>	y	y	y	y	y	y	y	y
<b>Cu-T (mg/L) - mean</b>	y	y	y	y	y	y	y	y
<b>Cu-T (mg/L) - 90<sup>th</sup> perc.</b>	y	y	y	y	y	y	y	y
<b>Mn-D (mg/L)</b>	y	y	y	y	y	y	n/a	n/a
<b>Pb-T (mg/L) - mean</b>	y	y	y	y	y	y	y	y
<b>Pb-T (mg/L) - max</b>	y	y	y	y	y	y	y	y
<b>Hg (µg/L)</b>	—	—	—	—	—	—	—	—
<b>Ni-T (mg/L)</b>	y	y	y	y	y	y	y	y
<b>Zn-T (mg/L) - mean</b>	y	y	y	y	y	y	y	y
<b>Zn-T (mg/L) - max</b>	y	y	y	y	y	y	y	y
<b>pH (pH units)</b>	y	y	y	y	y	y	y	y

"y" indicates objective met

"n" indicates objective exceeded; if applicable, the number of samples that exceeded the objective is shown

"—" indicates no data for that sampling period

**Table 6. Objective Attainment Results for 2008.**

	Site 1		Site 2		Site 3		Site 4	
	summer	fall	summer	fall	summer	fall	summer	fall
<b>Residue Non-filterable (mg/L)</b>	y	1	y	y	y	y	n/a	n/a
<b>Turbidity (NTU)</b>	y	y	y	y	y	y	n/a	n/a
<b>Ammonia:T (mg/L)</b>	y	y	y	y	y	y	y	y
<b>Nitrite Diss. (mg/L) - mean</b>	y	y	y	y	y	y	y	y
<b>Nitrite Diss. (mg/L) - max</b>	y	y	y	y	y	y	y	y
<b>Nitrate + Nitrite Diss. (mg/L)</b>	y	y	y	y	y	y	y	y
<b>Coli:Fec (CFU/100mL)</b>	y	y	y	y	n/a	n/a	n/a	n/a
<b>Al-D (mg/L) - mean</b>	y	y	y	y	y	n	y	n
<b>Al-D (mg/L) - max</b>	y	y	y	1	y	3	y	3
<b>As-T (mg/L)</b>	y	y	y	y	y	y	y	y
<b>Cd-T (µg/L)</b>	y	y	y	y	y	y	y	y
<b>Cr-T (µg/L)</b>	y	y	y	y	y	y	y	y
<b>Co-T (µg/L)</b>	y	y	y	y	y	y	y	y
<b>Cu-T (mg/L) - mean</b>	y	y	y	y	y	y	y	y
<b>Cu-T (mg/L) - 90<sup>th</sup> perc.</b>	y	y	y	y	y	y	y	y
<b>Mn-D (mg/L)</b>	y	y	y	y	y	y	n/a	n/a
<b>Pb-T (mg/L) - mean</b>	y	y	y	y	y	y	y	y
<b>Pb-T (mg/L) - max</b>	y	y	y	y	y	y	y	y
<b>Hg (µg/L)</b>	—	—	—	—	—	—	—	—
<b>Ni-T (mg/L)</b>	y	y	y	y	y	y	y	y
<b>Zn-T (mg/L) - mean</b>	y	y	y	y	y	y	y	y
<b>Zn-T (mg/L) - max</b>	y	y	y	y	y	y	y	y
<b>pH (pH units)</b>	y	y	y	y	y	y	y	y

"y" indicates objective met

"n" indicates objective exceeded; if applicable, the number of samples that exceeded the objective is shown

"—" indicates no data for that sampling period

## Particulate Matter – Turbidity and Non-filterable Residue

Note that for turbidity and non-filterable residue, there is a discrepancy between the Water Quality Objectives Technical Appendix and the Overview Report. The Technical Appendix includes turbidity and non-filterable residue objectives for Woodhus Creek, whereas the Overview Report says there are no objectives proposed for this site. For the purposes of this report, the Technical Appendix will be considered correct.

The turbidity objective of 5 NTU (maximum) was exceeded at Site 1 on two sampling occasions (5.1 NTU on November 14, 2001 and 13.7 NTU on October 19, 2003) (Table 7). All other measurements were below the objective. The non-filterable residue (NFR) objective of 12 mg/L (maximum) was also exceeded at Site 1 on two occasions (25.0 mg/L on October 19, 2003 and 26.0 mg/L on October 14, 2008) (Table 8). All other measurements were below 10 mg/L.

The turbidity objective of 7 NTU (90<sup>th</sup> percentile) was exceeded at Site 2 in two sampling periods (7.9 NTU in fall 2001, 16.0 NTU in fall 2003) (Table 7). Also, the 90<sup>th</sup> percentile was 6.9 NTU, just below the objective, in fall 2008. The NFR objective of 15 mg/L (90<sup>th</sup> percentile) was exceeded at Site 2 in two sampling periods (23.0 mg/L in fall 2001, 23.6 mg/L fall 2003) (Table 8).

At Site 3, the 90<sup>th</sup> percentile measurements for turbidity and NFR were well below the objectives of 7 NTU (90<sup>th</sup> percentile) and 15 mg/L (90<sup>th</sup> percentile), respectively, in all sampling periods.

Although no objectives were proposed for Site 4, the 90<sup>th</sup> percentile measurements for turbidity and NFR were below the objectives for Site 3 in all sampling periods.

As expected, all exceedances occurred during the high flow fall sampling periods. They also occurred only in the mainstem Oyster River. As stated in the Water Quality Objectives report, treatment for turbidity or suspended solids removal will be required if water from the Oyster River is to be used for drinking water purposes.

**Table 7. Summary of maximum or 90<sup>th</sup> percentile values for turbidity, calculated when a minimum of five samples were collected in a 30-day period. Greyed cells exceed the objective of 5 NTU (max) at Site 1 or 7 NTU (90<sup>th</sup> percentile) at Sites 2 and 3.**

Site	Fall 2001	Summer 2002	Fall 2002	Summer 2003	Fall 2003	Summer 2008	Fall 2008	Summer Mean	Fall Mean
Site 1	5.1	0.4	3.6	0.2	13.7	0.4	4.1	0.3	6.6
Site 2	7.9	0.5	4.3	0.3	16.0	0.4	6.9	0.4	9.1
Site 3	—	0.7	2.1	0.3	2.3	0.5	2.9	0.5	2.4
Site 4	—	4.0	3.7	4.4	4.7	4.4	6.3	4.3	4.9

**Table 8. Summary of maximum or 90<sup>th</sup> percentile values for non-filterable residue, calculated when a minimum of five samples were collected in a 30-day period. Greyed cells exceed the objective of 12 mg/L (max) at Site 1 or 15 mg/L (90<sup>th</sup> percentile) at Sites 2 and 3.**

Site	Fall 2001	Summer 2002	Fall 2002	Summer 2003	Fall 2003	Summer 2008	Fall 2008	Summer Mean	Fall Mean
Site 1	10	4	5	1	25	1	26	2	17
Site 2	23	2	7	1	24	1	10	1	13
Site 3	—	1	2	2	3	1	5	1	4
Site 4	—	4	7	3	6	5	6	4	6

## Nitrogen

When nitrogen objectives were developed in the Oyster River, there was concern about potential impacts on the river from the Mt. Washington ski resort sewage treatment plant (STP) effluent, as well as the potential for nitrogen levels to increase through the proposed mining activities (i.e. blasting). The STP was upgraded to include an advanced tertiary treatment system with ultra violet disinfection in the late 1990s. The STP discharges effluent into Piggott Creek, located in the headwaters of the Oyster River. Monitoring of the effluent and receiving stream was conducted in 2000 and results showed that ammonia and nitrate nitrogen were undetectable in the creek, concentrations of all parameters were within the provincial guidelines for the protection of aquatic life, and there were no signs of excessive algal growth in the creek. In addition, as mentioned above, the proposed mining activity did not occur. Although all nitrogen objectives were met at all sites (see below), nitrate levels and nitrate plus nitrite levels at Sites 3 and 4 were slightly higher than at Sites 1 and 2. Forest fertilization occurred in the Little Oyster watershed in 2004-2006, in Woodhus Creek in 2004 and 2006, in the upper Oyster River in 2006 and in the lower Oyster River in 2005. As attainment monitoring occurred before or several years after the fertilization, it is unlikely that forest fertilization had any effect on the nitrogen results. The slightly elevated levels may be due to natural variability and land use, including aging septic fields or agriculture.

### *Total Ammonia*

The toxicity of ammonia increases with pH and temperature. Water temperature was measured in 2008 in both summer and fall at all sites. To reflect the worst case scenario in summer and fall, the maximum temperature and pH values were used to calculate the ammonia objectives. In the summer these were 20°C and 8.1 pH units, respectively; in the fall these were 9.5°C and 8.8 pH units, respectively. In the summer, the mean ammonia objective would be 0.611 mg/L and the maximum objective would be 4.49 mg/L. In the fall, the mean ammonia objective would be 0.196 mg/L and the maximum objective would be 1.02 mg/L. These objectives were met at all sites in all sampling periods. The highest ammonia value recorded was 0.035 mg/L at Site 4 on August 10, 2003. Most measurements at all sites were below the detection limit of 0.005 mg/L. Note that in 2002 and 2003, dissolved rather than total ammonia was measured. However, given the very low dissolved ammonia results, it is extremely unlikely that total ammonia would have exceeded the objective.

### *Dissolved Nitrite*

Both the mean dissolved nitrite objective of 0.02 mg/L and the maximum objective of 0.06 mg/L were met at all sites. At Sites 1 and 2, most values were below the detection limit of 0.002 mg/L; the remaining measurements were well below the objective. At Sites 3 and 4, values were slightly higher but still well below the objective. The highest concentration, 0.017 mg/L, was measured at Site 4 on October 24, 2008.

### *Dissolved Nitrate plus Nitrite*

The nitrate plus nitrite objective of 10 mg/L was met at all sites for all sampling periods. The highest concentration, 1.57 mg/L, was measured at Site 4 on November 10, 2002. This was elevated relative to all other measurements, but was still well below the objective. As the next highest concentration at this site was 0.348 mg/L, it is likely that the reading on November 10, 2002 represents an anomaly.

### *Fecal Coliform*

The fecal coliform objective of 100 CFU/100mL (90<sup>th</sup> percentile) was exceeded at Site 1 in one sampling period (Table 9). The 90<sup>th</sup> percentile in summer 2003 was 126 CFU/100 mL, due primarily to one high reading of 200 CFU/100 mL on August 24, 2003. The fecal coliform objective was met at Site 2 in all sampling periods. The Mt Washington ski resort sewage treatment plant disinfects the final effluent using UV disinfection. As a result, fecal coliform measurements in the effluent are typically  $\leq 1$  CFU/100 mL; thus, the effluent does not appear to be contributing to elevated fecal coliform levels in the Oyster River system.

There are no fecal coliform objectives for Sites 3 or 4. At Site 3 on August 10, 2003, the fecal coliform measurement was 1,500 CFU/100 mL, bringing the 90<sup>th</sup> percentile to 910 CFU/100 mL. The next highest reading during this period was 24 CFU/100 mL (August 17, 2003). Turbidity and non-filterable residue were low at the time of the August 10, 2003 sample, and it is likely



that this reading represents an anomaly, such as sampling error or fecal contamination from wildlife. The fecal coliform measurements for Site 4 are elevated compared to other sampling locations. The 90<sup>th</sup> percentile in the summer of 2002 was 121 CFU/100 mL. The 90<sup>th</sup> percentile in the summer of 2003 was 254 CFU/100 mL, with four of the five samples above 100 CFU/100 mL. The 90<sup>th</sup> percentile in the summer 2008 sampling was 355 CFU/100 mL.

At the time that objectives were developed in 1990, there were insufficient data to recommend a bacteriological objective for Site 3 (Woodhus Creek) or Site 4 (Little Oyster River). Some fecal coliform sampling was done in 1992 and results from 2002-2008 are similar to the earlier data. Based on the land use in the watershed, it is likely that the source of any high bacteriological results is endemic wildlife. Because these bacteriological levels are likely natural, it is not recommended that objectives be developed for these sites.

**Table 9. Summary of 90<sup>th</sup> percentile values for fecal coliform, calculated when a minimum of five samples were collected within a 30-day period. Greyed cells exceed the objective of 100 CFU/100 mL which applies only to Sites 1 and 2.**

Site	Fall 2001	Summer 2002	Fall 2002	Summer 2003	Summer 2008	Fall 2008	Summer Mean	Fall Mean
Site 1	21	28	8	126	5	14	53	14
Site 2	88	20	72	17	20	45	19	68
Site 3	—	20	26	910	35	33	322	30
Site 4	—	121	60	254	355	47	243	54

## Metals

Metal speciation determines the biologically available portion of the total metal concentration. Only a portion of the total metals level is in a form which can be toxic to aquatic life. Naturally occurring organics in the watershed can bind substantial proportions of the metals which are present, forming metal complexes which are not biologically available. The relationship will vary both seasonally and depending upon the metal (e.g. copper has the highest affinity for binding sites on humic materials). Levels of organics as measured by dissolved organic carbon (DOC) vary from ecoregion to ecoregion. To aid in the interpretation of metals objectives and attainment, DOC should be included in the Oyster River monitoring program.

### *Dissolved Aluminum*

Both the mean dissolved aluminum objective of 0.05 mg/L and the maximum objective of 0.1 mg/L were met at Site 1 (Table 10). Most values were well below the objective, but one value was just below at 0.091 mg/L (November 2, 2008).

The objective was exceeded in two sampling periods at Site 2. In fall 2002, the mean objective was exceeded and one reading exceeded the maximum objective (0.205 mg/L on November 24). On November 2, 2008 the maximum objective was exceeded (0.103 mg/L) and the average was only slightly below the objective (0.0476 mg/L).

At Sites 3 and 4, both the mean and maximum objectives were exceeded in three of the six sampling periods (fall 2002, fall 2003 and fall 2008). The highest reading at Site 3 was 0.161 mg/L on November 2, 2008. The highest reading at Site 4 was 0.178 mg/L on November 11, 2003.

Results from the Oyster River attainment monitoring show that Woodhus Creek, Little Oyster River and the lower Oyster River have higher aluminum levels than the upper Oyster River. Sites 3 and 4 were not sampled for aluminum during the objectives development, but it is likely that these elevated levels represent background conditions. This has been noted in many watersheds on the east coast of Vancouver Island (BCMOE, 2010). Aluminum concentrations should continue to be monitored.

**Table 10. Summary of maximum and mean values for dissolved aluminum, calculated when a minimum of five samples were collected within a 30-day period. Greyed values exceed the objective of 0.1 mg/L (max) or 0.05 mg/L (mean).**

	Site	Summer 2002	Fall 2002	Summer 2003	Fall 2003	Summer 2008	Fall 2008	Summer Mean	Fall Mean
<b>max</b>	<b>Site 1</b>	0.0107	0.0518	0.0114	0.0632	0.0166	0.0910	0.0129	0.0687
	<b>Site 2</b>	0.0125	0.2050	0.0134	0.0801	0.0170	0.1030	0.0143	0.1294
	<b>Site 3</b>	0.0071	0.1310	0.0083	0.1490	0.0162	0.1610	0.0105	0.1470
	<b>Site 4</b>	0.0191	0.1300	0.0253	0.1780	0.0334	0.1590	0.0259	0.1557
<b>mean</b>	<b>Site 1</b>	0.0093	0.0254	0.0091	0.0283	0.0116	0.0421	0.0100	0.0319
	<b>Site 2</b>	0.009	0.0641	0.0105	0.0363	0.0113	0.0476	0.0103	0.0493
	<b>Site 3</b>	0.0058	0.0691	0.0063	0.0755	0.0114	0.0981	0.0078	0.0809
	<b>Site 4</b>	0.0177	0.0653	0.0228	0.1288	0.0227	0.1094	0.0211	0.1012

#### *Total Arsenic*

The total arsenic objective of 0.05 mg/L was met at all sites in all sampling periods. Most measurements were only slightly above the detection limit of 0.0001 mg/L. During the objectives development monitoring, the detection limit (0.3 mg/L) was higher than the guideline and it was thus difficult to tell whether arsenic exceeded the provincial guideline. The lower detection limit used during the attainment monitoring confirms that arsenic does not pose a problem in the Oyster River watershed.

#### *Total Cadmium*

The total cadmium objective of 0.2 µg/L was exceeded on one occasion at Site 4 (0.47 µg/L on August 4, 2003). Turbidity was 4.73 NTU, the highest reading of the 5-in-30 summer 2003 sampling, but there had not been any rainfall for approximately two weeks prior to this date (Environment Canada, 2009) so the cause of the elevated cadmium result remains unclear. Dissolved cadmium was substantially lower than total cadmium in this sample, so it is likely that the elevated result was linked to high suspended solids, and perhaps the result of stirring up bottom sediments while collecting the sample during low-flow conditions. As this one sample is substantially elevated compared to all other results, this result is assumed to be an anomaly.

At Site 1, on September 8, 2002 the concentration was 0.16 µg/L, just slightly below the objective. Most other measurements were below the detection limit, which was 0.01 µg/L in 2001 to 2003, and 0.005 µg/L in 2008. As with arsenic, these detection limits were lower than during the objectives development monitoring and allowed a more accurate assessment of the cadmium concentrations in the watershed.

#### *Total Chromium*

The total chromium objective of 2 µg/L was exceeded on one occasion at Site 4 (4.1 µg/L on August 4, 2003). This is the same date as the cadmium exceedance, but as mentioned was not associated with substantially elevated turbidity or rainfall. The reason for this elevated result remains unclear, although similarly to cadmium, the dissolved chromium result was lower than the total chromium, suggesting a link to suspended solids and therefore representing an anomaly.

One measurement at Site 3, 1.0 µg/L on October 26, 2003, was only slightly below the objective. Most other measurements were below the detection limit, which was 0.2 µg/L in 2001 to 2003 and 0.1 µg/L in 2008. As with arsenic and cadmium, these detection limits were lower than during objectives development monitoring and allowed a more accurate assessment of the chromium concentrations.

#### *Total Cobalt*

The total cobalt objective of 50 µg/L was met at all sites in all sampling periods. Many measurements were below the detection limit of 0.005 µg/L, and all were well below the objective. As with several other metals, the cobalt detection limit had been above the guidelines during the objectives development monitoring, and the lower detection limit used during attainment monitoring allows for a more accurate assessment of this parameter.

### *Total Copper*

Both the mean total copper objective of 3 µg/L and the 90<sup>th</sup> percentile objective of 5 µg/L were met at Sites 1 and 2 in all sampling periods. The 90<sup>th</sup> percentile objective of 10 µg/L was met at Sites 3 and 4 in all sampling periods. Most values were well below the objective. There appears to have been a reduction in copper levels in the watershed since the objectives development monitoring was conducted. The 90<sup>th</sup> percentile measurements and means have decreased at all sites. No significant sources of copper were identified during the objectives development, and it is unclear whether these lower levels reflect a true decrease or perhaps a change in laboratory analytical methods since the objectives were developed.

Values at Site 4 are slightly elevated compared with the other sites, but remain below the objective.

### *Dissolved Iron*

Dissolved iron was sampled in 2008 only. The dissolved iron objective of 0.3 mg/L (90<sup>th</sup> percentile) was met at Sites 1 and 2 (Table 11). All values were well below the objective.

During objectives development monitoring, it was found that Woodhus Creek and Little Oyster River had naturally high levels of iron, with the latter having the highest concentrations. The same was found during the attainment monitoring.

Although no iron objective has been proposed for Sites 3 or 4 due to naturally high levels, Site 3 met the provincial guideline of 0.35 mg/L. Values were highest during the fall sampling, and the highest was 0.208 mg/L on November 2, 2008, coinciding with increased rainfall in the four days prior to sampling (Environment Canada, 2009). At Site 4, however, all but one of the measured values were above the provincial guideline. The 90<sup>th</sup> percentiles were 0.8278 mg/L and 0.7408 mg/L in the summer and fall sampling, respectively. The fact that Little Oyster River appears to have higher iron concentrations than Woodhus Creek should be taken into account if objectives are developed for these streams in the future. As iron data was only collected for one year, it is recommended that additional data be collected before potentially developing objectives for Sites 3 and 4.

Note that the provincial water quality guideline for dissolved iron was increased in 2008 from 0.3 mg/L to 0.35 mg/L (Phippen *et al.*, 2008). The Oyster River objective was based on provincial water quality guidelines, and as such it is recommended that this objective be updated.

**Table 11. Summary of 90<sup>th</sup> percentile values for dissolved iron, calculated when a minimum of five samples were collected within a 30-day period. An objective of 0.3 mg/L (90<sup>th</sup> percentile) was proposed for Sites 1 and 2 only.**

Site	Summer 2008	Fall 2008
Site 1	0.004	0.036
Site 2	0.018	0.078
Site 3	0.064	0.189
Site 4	0.828	0.741

#### *Total Lead*

The toxicity of lead increases with decreasing hardness. The lead objective varies depending on whether hardness is greater than or less than 8 mg/L CaCO<sub>3</sub>. Only two hardness measurements were made during the objectives development monitoring (11.0 mg/L CaCO<sub>3</sub> and 12.3 mg/L CaCO<sub>3</sub>). Hardness was measured again in 2008, and values ranged from 13.74 mg/L CaCO<sub>3</sub> (Site 1) to 44.62 mg/L CaCO<sub>3</sub> (Site 4).

Using the lowest hardness values measured in 2008 (Site 1), the mean objective is 3.607 µg/L and the maximum objective is 7.296 µg/L. Based on this, the total lead objective was met at all sites for all sampling periods; all measurements well below the objective. Hardness was not measured in 2001-2003, so it is not possible to calculate exact objectives for lead in these years. However, if hardness was approximately the same as it was in 2008, the objective would have been met in these years as well.

An objective was proposed for lead in fish tissue, but no samples were taken during the objectives development or attainment monitoring. As mining has not occurred in the watershed and lead levels did not exceed the objectives, fish tissue monitoring remains a low priority and the objectives report should be updated to remove this recommendation.

#### *Dissolved Manganese*

The dissolved manganese objective of 0.05 mg/L was met at Sites 1, 2, and 3. All values were well below the objective.

No manganese objective has been proposed for Site 4 due to naturally high levels. Nearly all values in the summer and fall 2002 sampling, as well as the summer 2003 sampling, exceeded the objective proposed for the other sites. However, in the fall of 2003 and the summer and fall of 2008, manganese concentrations were much lower, and were all below the objective that exists for Sites 1-3. This may suggest a reduction in levels over time, or the decrease may be related to changes in laboratory analytical methods.

### *Mercury*

Mercury was not sampled during attainment monitoring as there is no known natural or anthropogenic source in the watershed. As such, it is not possible to comment on whether the objective has been met. When the objectives were developed, they were to be considered tentative until additional data, analyzed at lower detection limits, established the mercury concentrations in the watershed. Analysis methods for mercury have improved since the Water Quality Objectives were developed, and current detection limits are below the objective of 0.02 µg/L.

Mercury is not expected to be a concern and mining has not occurred in the watershed since the objectives were developed. The objectives report also that all resident fish species consumed by humans should be monitored for mercury levels. This sampling is not a priority, and it is recommended that the Water Quality Objectives report be updated to remove this recommendation.

### *Total Nickel*

The total nickel objective of 0.025 mg/L was met at all sites for all sampling periods. All measured values were well below the objective. As with several other metals, the nickel detection limit had been above the guidelines during the objectives development monitoring, and the lower detection limit used during attainment monitoring allowed for a more accurate assessment of this parameter.

### *Total Zinc*

Both the mean total zinc objective of 0.01 mg/L and the maximum objective of 0.03 mg/L were met at all sites in all sampling events. All measured values were well below the objectives. There appears to have been a reduction in zinc concentration since the objectives development monitoring. At that time, several values exceeded 0.01 mg/L, and during the attainment monitoring none of the values exceeded this level. As with copper, it is unclear whether this reflects a true decrease in levels, or perhaps a change in laboratory analytical methods.

Note that the provincial water quality guideline for zinc was changed in 1999 to incorporate water hardness (Nagpal, 1999). The Oyster River objective was based on provincial water quality guidelines, as such is it recommended that this objective be updated.

### *pH*

The pH objective is a range of 6.5 to 8.5, which was met at Sites 1, 3 and 4 in all sampling events. Most measurements were well within the guidelines. On August 4, 2003, the pH at Site 4 was 6.9, only slightly above the minimum objective.

One value at Site 2 exceeded the maximum objective of 8.5, at a pH of 8.8 on November 17, 2002. On one other occasion, September 7, 2008, the pH at this site was 8.1, only slightly below the maximum objective. The 95<sup>th</sup> percentile objective of 6.5 was met at Site 2 in all sampling periods.

## Summary and Recommendations

The water quality objectives were met for most parameters. In general, the Oyster River mainstem occasionally had elevated suspended solids and fecal coliforms, while Woodhus Creek and Little Oyster River had some elevated metal and bacteriological concentrations.

The non-filterable residue and turbidity objectives were exceeded in the Oyster River mainstem sites. The aluminum objective was exceeded in both Woodhus Creek and Little Oyster River, as well as in the Oyster River mainstem below these tributaries. The cadmium and chromium objectives were exceeded in the Little Oyster River on one occasion. The fecal coliform objective was exceeded in the Oyster River upstream site on one occasion. The pH objective was exceeded in the Oyster River downstream site on one occasion. Most exceedances happened during the fall high flow period. The exceedances of the fecal coliform, cadmium and chromium objectives happened during the summer low flow period.

It is recommended that the iron objective for Sites 1 and 2 be updated to reflect the recent change in the provincial guideline for this parameter. The reference in the Objectives report to sampling fish tissue for lead and mercury should be removed as mining has not occurred in the watershed and this sampling is no longer a priority. Finally, dissolved organic carbon should continue to be included in the attainment monitoring because it aids in the interpretation of the metals data.



## References

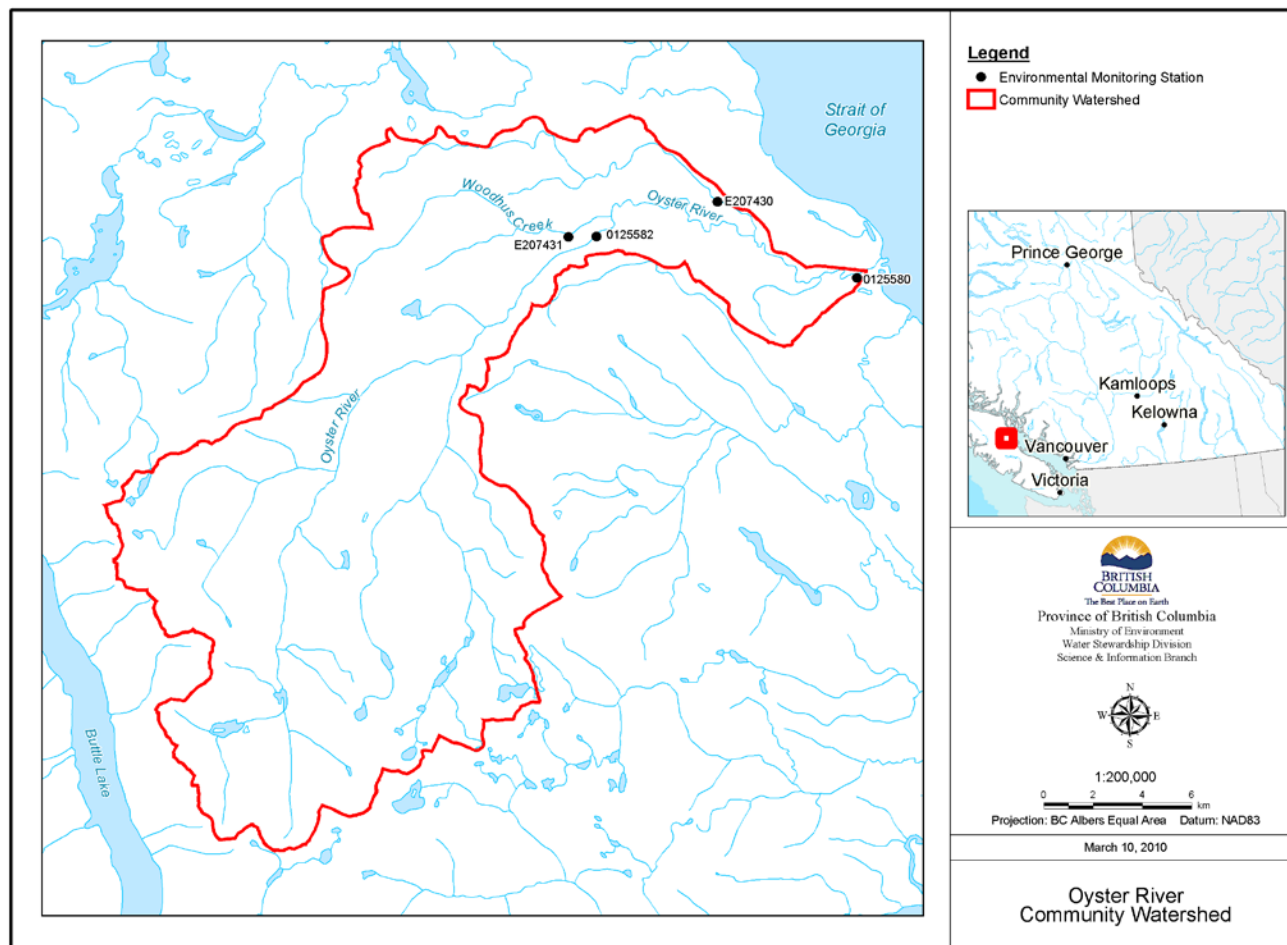
- B.C. Ministry of Environment (BCMOE). 2010 *in progress*. Water Quality Assessment and Objectives for the Englishman River Community Watershed. Environmental Protection Division and Water Stewardship Division, British Columbia Ministry of Environment, Victoria, B.C.
- B.C. Ministry of Environment. 2006. British Columbia Approved Water Quality Guidelines – 2006 Edition. Water Quality Branch, Environmental Protection Division, British Columbia Ministry of Environment. Victoria, B.C. Available online at:  
[http://www.env.gov.bc.ca/wat/wq/wq\\_guidelines.html#approved](http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved)
- B.C. Ministry of Environment. 2006. A Compendium of Working Water Quality Guidelines for British Columbia. Science and Information Branch, Environmental Protection Division, British Columbia Ministry of Environment. Victoria, B.C. Available online at:  
<http://www.env.gov.bc.ca/wat/wq/BCguidelines/working.html>
- Demarchi, D.A. 1995. *Ecoregions of British Columbia. Fourth Edition*. British Columbia Wildlife Branch, Ministry of Environment, Lands and Parks, Victoria B.C. Map (1:2,000,000).
- Deniseger, J., Epps, D., Barlak, R., Swain, L. 2009. Use of the Ecoregion Approach to Setting Water Quality Objectives in the Vancouver Island Region, British Columbia Ministry of Environment. B.C. Ministry of Environment, Vancouver Island Region.
- Environment Canada. 2009. National Climate and Data Information Archive.  
[http://www.climate.weatheroffice.gc.ca/Welcome\\_e.html](http://www.climate.weatheroffice.gc.ca/Welcome_e.html) Accessed on November 30, 2009.
- Nagpal, N.K. 1990a. Ambient Water Quality Assessment and Objectives for the Oyster River Basin Campbell River Area. B.C. Ministry of Environment. Victoria, B.C.
- Nagpal, N.K. 1990b. Campbell River Area Oyster River Basin Water Quality Assessment and Objectives Technical Appendix. B.C. Ministry of Environment. Victoria, B.C.
- Nagpal, N.K. 1999. Ambient Water Quality Guidelines for Zinc. Overview. B.C. Ministry of Environment, Lands and Parks. Victoria, B.C.
- Phippen, B., Horvath, C., Nordin, R., and Nagpal, N. 2008. Ambient Water Quality Guidelines for Iron. Science and Information Branch, Water Stewardship Division, British Columbia Ministry of Environment. Victoria, B.C. Available online at:  
[http://www.env.gov.bc.ca/wat/wq/BCguidelines/iron/iron\\_tech.pdf](http://www.env.gov.bc.ca/wat/wq/BCguidelines/iron/iron_tech.pdf)



## Appendix



Figure 1. Vancouver Island Ecoregions.



**Figure 2. Oyster River Watershed and Sampling Locations.**

Table 12. Summary data from Site 1, Oyster River upstream of Woodhus Creek and Little Oyster River for 2001, 2002, 2003 and 2008.

Site, Sampling Period		Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N.Kjel:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P--T (mg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)
Site 1	Number		5											5									5	5	5		5	5		5
2001	Min		2											2									0.022	0.024	0.002		5	0.3		6.34
Fall	Max		23											31									0.038	0.040	0.002		10	5.1		7.36
	Mean		7											9									0.028	0.030	0.002		6	1.6		6.99
	90th Perc.		16											21									0.034	0.036	0.002		8	3.6		7.30
	St. Dev.		9											12									9.028	9.028	9.028		9	9.0		9.03
Site 1	Number		5			5	5	5	5	5	5	5	5	5	5	5				5		5		5		5	5	5	5	5
2002	Min		1			0.06	0.002	0.002	7.1	0.005	0.2	0.01	0.005	1	0.2	0.32				0.093		0.05		0.036		0.04	1	0.1	0.1	7.60
Summer	Max		25			0.10	0.002	0.002	10.7	0.005	0.3	0.06	0.005	36	0.2	2.71				0.412		0.05		0.070		0.12	4	0.4	1.9	7.60
	Mean		8			0.08	0.002	0.002	9.3	0.005	0.2	0.02	0.005	12	0.2	1.02				0.242		0.05		0.053		0.09	2	0.2	0.5	7.60
	90th Perc.		19			0.09	0.002	0.002	10.5	0.005	0.3	0.04	0.005	28	0.2	2.14				0.357		0.05		0.066		0.12	4	0.3	1.2	7.60
	St. Dev.		10			0.01	0.000	0.000	1.4	0.000	0.1	0.02	0.000	15	0.0	1.02				0.118		0.00		0.013		0.03	1	0.1	0.8	0.00
Site 1	Number		5			5	5	5	5	5	5	5	5	5	5	5				5		5		5		5	5	5		5
2002	Min		1			0.08	0.002	0.002	2.3	0.005	0.1	0.01	0.005	2	0.2	0.64				0.336		0.05		0.020		0.09	1	0.3	0.1	7.10
Fall	Max		4			0.19	0.008	0.007	51.8	0.006	0.3	0.04	0.049	9	0.2	1.55				0.715		0.19		0.079		0.15	5	3.6	0.7	7.60
	Mean		3			0.12	0.005	0.004	25.4	0.005	0.2	0.02	0.014	5	0.2	1.11				0.509		0.08		0.053		0.12	2	1.1	0.2	7.30
	90th Perc.		4			0.16	0.008	0.006	47.0	0.006	0.3	0.03	0.031	8	0.2	1.54				0.675		0.13		0.077		0.15	4	2.5	0.5	7.48
	St. Dev.		2			0.04	0.002	0.002	21.6	0.001	0.1	0.01	0.020	3	0.0	0.40				0.162		0.06		0.030		0.03	2	1.4	0.3	0.19
Site 1	Number		5			5	5	5	5	5	5	5	5	5	5	5				5		5		5		5	5	5	5	5
2003	Min		1			0.03	0.002	0.002	6.3	0.005	0.2	0.01	0.005	1	0.2	0.52				0.022		0.05		0.032		0.01	1	0.1	0.1	7.40
Summer	Max		150			0.09	0.004	0.003	11.4	0.025	0.4	0.01	0.032	200	0.2	0.61				0.228		0.05		0.087		0.01	1	0.2	1.2	7.60
	Mean		35			0.06	0.002	0.002	9.1	0.009	0.3	0.01	0.016	44	0.2	0.57				0.170		0.05		0.045		0.01	1	0.2	0.4	7.54
	90th Perc.		97			0.09	0.003	0.003	11.2	0.017	0.4	0.01	0.027	126	0.2	0.61				0.225		0.05		0.067		0.01	1	0.2	0.8	7.60
	St. Dev.		65			0.02	0.001	0.000	2.2	0.009	0.1	0.00	0.011	87	0.0	0.04				0.085		0.00		0.023		0.00	0	0.0	0.5	0.09

Table 12. Continued...

Site, Sampling Period		Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N.Kjel:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P--T (mg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)
Site 1	Number					5	5	5	5	5	5	5	5		5	5				5		5		5		5	5	5	5	5
2003	Min					0.05	0.002	0.002	12.9	0.005	0.1	0.01	0.005		0.2	0.52				0.213		0.05		0.012		0.01	1	0.3	0.1	7.20
Fall	Max					0.14	0.022	0.008	63.2	0.005	0.3	0.01	0.126		0.9	2.12				2.160		0.32		0.040		0.02	25	13.7	0.7	7.50
	Mean					0.09	0.008	0.003	28.3	0.005	0.2	0.01	0.036		0.4	0.97				0.754		0.12		0.026		0.01	6	3.2	0.4	7.36
	90th Perc.					0.13	0.017	0.006	48.5	0.005	0.3	0.01	0.086		0.7	1.59				1.521		0.23		0.038		0.02	16	8.7	0.7	7.46
	St. Dev.					0.04	0.008	0.003	20.1	0.000	0.1	0.00	0.051		0.3	0.65				0.797		0.11		0.012		0.00	11	5.9	0.3	0.11
Site 1	Number	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
2008	Min	0.5	1	0.02	0.02	0.06	0.002	0.002	9.4	0.005	0.3	0.01	0.009	1	0.1	0.36	1	14.6	15	0.130	0.03	0.05	0.030	0.030	0.002	0.01	1	0.2	0.1	7.30
Summer	Max	2.4	5	0.06	0.05	0.10	0.006	0.003	16.6	0.005	0.3	0.01	0.019	6	0.1	0.57	4	16.1	16	0.270	0.06	0.18	0.056	0.056	0.002	0.04	1	0.4	0.4	7.70
	Mean	1.2	3	0.04	0.04	0.08	0.003	0.002	11.6	0.005	0.3	0.01	0.011	3	0.1	0.45	3	15.5	16	0.214	0.04	0.08	0.039	0.039	0.002	0.01	1	0.3	0.2	7.50
	90th Perc.	1.9	4	0.06	0.05	0.10	0.005	0.003	14.3	0.005	0.3	0.01	0.015	5	0.1	0.53	4	16.0	16	0.270	0.05	0.14	0.050	0.050	0.002	0.02	1	0.4	0.3	7.66
	St. Dev.	0.7	2	0.02	0.01	0.02	0.002	0.000	2.8	0.000	0.0	0.00	0.004	2	0.0	0.08	1	0.6	0	0.059	0.01	0.05	0.011	0.011	0.000	0.01	0	0.1	0.1	0.16
Site 1	Number	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
2008	Min	2.3	1	0.02	0.02	0.05	0.003	0.003	16.4	0.005	0.2	0.01	0.013	1	0.1	0.59	6	11.9	12	0.200	0.01	0.08	0.006	0.006	0.002	0.01	1	0.3	0.1	7.20
Fall	Max	4.2	14	0.09	0.09	0.10	0.009	0.008	91.0	0.005	0.4	0.01	0.134	17	0.3	2.34	46	15.8	15	1.230	0.03	0.36	0.027	0.027	0.002	0.03	26	4.1	0.4	7.60
	Mean	3.5	5	0.05	0.05	0.07	0.005	0.004	42.1	0.005	0.3	0.01	0.045	6	0.2	1.14	19	13.8	14	0.504	0.02	0.15	0.017	0.017	0.002	0.01	8	1.2	0.2	7.42
	90th Perc.	4.1	11	0.07	0.07	0.09	0.007	0.006	72.5	0.005	0.3	0.01	0.094	14	0.3	1.83	36	15.2	15	0.930	0.03	0.26	0.025	0.025	0.002	0.02	18	2.8	0.3	7.56
	St. Dev.	0.7	6	0.03	0.03	0.02	0.002	0.002	30.0	0.000	0.1	0.00	0.050	7	0.1	0.70	16	1.5	1	0.418	0.01	0.12	0.008	0.008	0.000	0.01	11	1.6	0.1	0.15

Table 13. Summary data from Site 2, Oyster River downstream of Woodhus Creek and Little Oyster River for 2001, 2002, 2003 and 2008.

Site, Sampling Period		Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N Kjeh:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P--T (mg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)	
Site 2	Number		6							6				6									6	6	6		6	6		6	
2001	Min		10							0.005				12									0.002	0.004	0.002		5	0.43		7.22	
Fall	Max		140							0.026				140									0.126	0.128	0.002		35	12.00		7.59	
	Mean		37							0.009				38									0.041	0.043	0.002		12	3.49		7.39	
	90th Perc.		86							0.016				88									0.088	0.090	0.002		23	7.90		7.54	
	St. Dev.		51							0.009				51									0.044	0.044	0.000		12	4.45		0.14	
Site 2	Number	5	5			5	5	5	5	5	5	5	5	5	5	5				5		5		5		5	5	5	5	5	5
2002	Min	0.6	1			0.06	0.002	0.002	5.8	0.005	0.2	0.01	0.005	1	0.2	0.27				0.911		0.05		0.031		0.06	1	0.24	0.1	7.60	
Summer	Max	0.8	16			0.09	0.003	0.005	12.5	0.005	0.2	0.16	0.005	23	0.2	0.61				1.740		0.05		0.046		0.12	2	0.49	0.3	7.70	
	Mean	0.7	8			0.08	0.002	0.003	9.0	0.005	0.2	0.04	0.005	11	0.2	0.51				1.470		0.05		0.036		0.09	1	0.35	0.2	7.62	
	90th Perc.	0.8	15			0.09	0.003	0.004	11.5	0.005	0.2	0.10	0.005	20	0.2	0.60				1.736		0.05		0.042		0.12	2	0.46	0.3	7.66	
	St. Dev.	0.1	7			0.02	0.000	0.001	2.5	0.000	0.0	0.07	0.000	10	0.0	0.14				0.341		0.00		0.006		0.03	0	0.10	0.1	0.04	
Site 2	Number	6	6	5	5	6	6	6	5	5	5	5	5	5	5	5				5		5		5		5	5	5	5	5	5
2002	Min	0.1	1	0.04	0.1	0.02	0.000	0.001	3.4	0.005	0.1	0.01	0.005	1	0.2	0.63				1.050		0.05		0.002		0.01	1	0.19	0.1	7.20	
Fall	Max	4.3	41	0.15	0.2	0.31	0.014	0.011	205.0	0.005	0.2	0.01	0.153	110	0.2	2.30				1.980		0.21		0.160		0.14	10	6.60	0.8	8.80	
	Mean	2.2	10	0.09	0.1	0.14	0.005	0.005	64.1	0.005	0.2	0.01	0.036	27	0.2	1.21				1.582		0.08		0.070		0.08	3	1.73	0.3	7.56	
	90th Perc.	4.3	25	0.15	0.1	0.29	0.012	0.010	148.2	0.005	0.2	0.01	0.097	72	0.2	1.99				1.884		0.15		0.141		0.12	7	4.34	0.6	8.20	
	St. Dev.	1.6	17	0.05	0.0	0.12	0.005	0.004	83.0	0.000	0.0	0.00	0.065	46	0.0	0.70				0.344		0.07		0.069		0.05	4	2.74	0.3	0.69	
Site 2	Number		5			5	5	5	5	5	5	5	5	5	5	5				5		5		5		5	5	5	5	5	5
2003	Min		1			0.04	0.002	0.002	6.2	0.005	0.2	0.01	0.005	1	0.2	0.61				0.163		0.05		0.012		0.01	1	0.23	0.2	7.40	
Summer	Max		10			0.10	0.006	0.006	13.4	0.005	0.4	0.04	0.035	20	0.2	2.38				1.330		0.11		0.055		0.12	1	0.31	1.6	7.70	
	Mean		4			0.06	0.003	0.003	10.5	0.005	0.3	0.02	0.022	9	0.2	1.06				0.830		0.06		0.027		0.03	1	0.26	0.6	7.58	
	90th Perc.		8			0.08	0.004	0.004	13.1	0.005	0.4	0.03	0.035	17	0.2	1.80				1.246		0.09		0.044		0.08	1	0.29	1.2	7.66	
	St. Dev.		4			0.02	0.002	0.002	2.9	0.000	0.1	0.01	0.013	8	0.0	0.75				0.444		0.03		0.016		0.05	0	0.03	0.6	0.11	

Table 13. Continued....

Site, Sampling Period		Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N.Kjel:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P--T (mg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)
Site 2	Number					5	5	5	5	5	5	5	5		5	5				5		5		5	5	5	5	5	5	5
2003	Min					0.10	0.002	0.002	16.3	0.005	0.1	0.01	0.012		0.2	0.73				0.592		0.05		0.035		0.01	1	0.29	0.1	7.20
Fall	Max					0.21	0.029	0.008	80.1	0.005	0.4	0.01	0.389		0.9	4.10				2.870		0.54		0.065		0.08	38	25.00	1.4	7.50
	Mean					0.15	0.012	0.004	36.3	0.005	0.2	0.01	0.100		0.4	1.58				1.614		0.19		0.049		0.03	9	5.96	0.5	7.34
	90th Perc.					0.20	0.025	0.006	66.1	0.005	0.3	0.01	0.254		0.7	2.93				2.438		0.38		0.061		0.06	24	15.99	1.0	7.46
	St. Dev.					0.05	0.011	0.002	25.4	0.000	0.1	0.00	0.163		0.3	1.42				0.830		0.20		0.012		0.03	16	10.68	0.5	0.11
Site 2	Number	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
2008	Min	0.5	1	0.02	0.0	0.04	0.002	0.002	7.7	0.005	0.2	0.01	0.011	2	0.1	0.44	13	14.9	16.6	0.100	0.01	0.03	0.008	0.008	0.002	0.01	1	0.20	0.1	7.30
Summer	Max	1.9	17	0.06	0.1	0.08	0.005	0.003	17.0	0.005	0.3	0.01	0.015	24	0.1	0.59	20	17.1	17.0	0.810	0.02	0.10	0.024	0.026	0.004	0.08	1	0.40	1.2	8.10
	Mean	1.0	7	0.04	0.0	0.06	0.004	0.003	11.3	0.005	0.3	0.01	0.013	10	0.1	0.51	15	16.3	16.8	0.490	0.02	0.07	0.015	0.016	0.002	0.02	1	0.28	0.4	7.58
	90th Perc.	1.7	13	0.06	0.1	0.08	0.005	0.003	15.0	0.005	0.3	0.01	0.014	20	0.1	0.59	18	17.0	16.9	0.774	0.02	0.09	0.022	0.024	0.003	0.06	1	0.36	0.8	7.90
	St. Dev.	0.6	6	0.02	0.0	0.02	0.001	0.001	3.6	0.000	0.0	0.00	0.002	9	0.0	0.07	3	0.9	0.2	0.283	0.01	0.03	0.007	0.008	0.001	0.03	0	0.08	0.5	0.31
Site 2	Number	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
2008	Min	2.5	2	0.03	0.0	0.04	0.003	0.003	17.0	0.005	0.3	0.01	0.016	3	0.1	0.75	29	12.3	12.7	0.420	0.00	0.09	0.002	0.002	0.002	0.01	1	0.40	0.1	7.10
Fall	Max	5.2	61	0.09	0.1	0.20	0.009	0.009	103.0	0.005	0.4	0.01	0.131	69	0.3	2.66	89	16.8	16.9	1.570	0.14	0.32	0.140	0.146	0.006	0.04	16	10.30	0.5	7.60
	Mean	4.0	16	0.06	0.1	0.11	0.006	0.005	47.6	0.005	0.3	0.01	0.047	19	0.2	1.31	49	14.9	15.1	0.804	0.05	0.15	0.047	0.048	0.003	0.02	4	2.64	0.3	7.40
	90th Perc.	5.1	40	0.09	0.1	0.18	0.009	0.007	88.1	0.005	0.4	0.01	0.094	45	0.3	2.10	78	16.4	16.8	1.318	0.11	0.25	0.110	0.114	0.004	0.03	10	6.86	0.5	7.56
	St. Dev.	1.1	25	0.03	0.0	0.07	0.002	0.002	36.8	0.000	0.1	0.00	0.048	28	0.1	0.78	26	1.7	1.8	0.472	0.06	0.10	0.058	0.060	0.002	0.01	7	4.32	0.2	0.19



Table 14. Summary data from Site 3, Woodhus Creek for 2002, 2003 and 2008.

Site, Sampling Period		Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N. Kjel:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P--T (mg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)	
Site 3	Number		5			5	5	5	5	5	5	5	5	5	5	5				5		5		5		5	5	5	5	5	5
2002	Min		4			0.11	0.002	0.003	4.3	0.005	0.1	0.01	0.005	7	0.2	0.16				0.846		0.05		0.039		0.04	1	0.17	0.1	7.7	
Summer	Max		17			0.14	0.010	0.007	7.1	0.005	0.2	0.01	0.005	24	0.2	0.56				1.290		0.05		0.108		0.12	1	0.91	0.6	7.9	
	Mean		10			0.12	0.005	0.004	5.8	0.005	0.2	0.01	0.005	15	0.2	0.33				0.994		0.05		0.075		0.09	1	0.36	0.3	7.8	
	90th Perc.		14			0.14	0.008	0.006	7.1	0.005	0.2	0.01	0.005	20	0.2	0.48				1.171		0.05		0.103		0.12	1	0.67	0.6	7.9	
	St. Dev.		5			0.02	0.003	0.002	1.2	0.000	0.0	0.00	0.000	6	0.0	0.15				0.174		0.00		0.028		0.03	0	0.31	0.2	0.1	
Site 3	Number		5			5	5	5	5	5	5	5	5	5	5	5				5		5		5		5	5	5	5	5	5
2002	Min		1			0.06	0.002	0.005	6.4	0.005	0.1	0.01	0.005	1	0.2	0.41				2.180		0.05		0.002		0.01	1	0.33	0.1	7.1	
Fall	Max		18			0.71	0.017	0.013	131.0	0.007	0.5	0.01	0.075	37	0.2	1.79				5.860		0.17		0.378		0.14	2	2.28	1.7	7.5	
	Mean		6			0.36	0.008	0.008	69.1	0.005	0.3	0.01	0.021	10	0.2	1.03				4.020		0.09		0.180		0.08	1	1.10	0.7	7.3	
	90th Perc.		14			0.66	0.015	0.011	128.6	0.006	0.4	0.01	0.051	26	0.2	1.65				5.812		0.16		0.340		0.14	2	2.09	1.3	7.4	
	St. Dev.		7			0.29	0.006	0.003	60.8	0.001	0.2	0.00	0.030	15	0.0	0.58				1.722		0.06		0.170		0.06	1	0.88	0.7	0.2	
Site 3	Number		5			5	5	5	5	5	5	5	5	5	5	5				5		5		5		5	5	5	5	5	5
2003	Min		1			0.06	0.002	0.002	3.8	0.005	0.2	0.01	0.005	3	0.2	0.37				0.211		0.05		0.047		0.01	1	0.14	0.2	7.7	
Summer	Max		1500			0.14	0.005	0.007	8.3	0.008	0.4	0.01	0.030	1500	0.4	0.50				0.755		0.09		0.077		0.01	3	0.33	0.3	7.8	
	Mean		305			0.11	0.003	0.003	6.3	0.006	0.3	0.01	0.018	309	0.2	0.46				0.470		0.06		0.062		0.01	1	0.19	0.3	7.8	
	90th Perc.		904			0.13	0.004	0.005	8.1	0.007	0.4	0.01	0.029	910	0.3	0.49				0.651		0.07		0.075		0.01	2	0.27	0.3	7.8	
	St. Dev.		668			0.03	0.001	0.002	2.0	0.001	0.1	0.00	0.011	666	0.1	0.05				0.194		0.02		0.012		0.00	1	0.08	0.0	0.0	

Table 14. Continued...

Site, Sampling Period		Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N.Kjel:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P--T (mg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)
Site 3	Number					5	5	5	5	5	5	5	5		5	5				5		5		5		5	5	5	5	5
2003	Min					0.24	0.003	0.003	33.2	0.005	0.1	0.01	0.042		0.2	0.75				2.030		0.16		0.090		0.01	1	0.44	0.3	7.0
Fall	Max					0.46	0.011	0.010	149.0	0.005	0.3	0.01	0.089		1.0	1.52				6.840		0.37		0.191		0.04	5	2.90	2.3	7.5
	Mean					0.31	0.008	0.006	75.5	0.005	0.2	0.01	0.054		0.4	1.07				3.834		0.25		0.131		0.02	2	1.20	0.7	7.3
	90th Perc.					0.40	0.011	0.009	120.3	0.005	0.3	0.01	0.073		0.8	1.35				6.032		0.32		0.171		0.03	3	2.31	1.5	7.5
	St. Dev.					0.09	0.003	0.003	44.1	0.000	0.1	0.00	0.020		0.3	0.28				1.994		0.08		0.038		0.01	2	1.03	0.9	0.2
Site 3	Number	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
2008	Min	1	4	0.02	0.02	0.13	0.005	0.004	9.0	0.000	0.3	0.01	0.012	11	0.1	0.42	24	24.3	27.3	0.170	0.07	0.08	0.065	0.067	0.002	0.01	1	0.20	0.1	7.4
Summer	Max	3	25	0.09	0.09	0.20	0.008	0.005	16.2	0.009	0.3	0.01	0.018	44	0.1	0.70	76	28.5	28.0	0.510	0.13	9.17	0.126	0.129	0.003	0.02	1	0.60	0.5	7.7
	Mean	2	13	0.05	0.04	0.16	0.006	0.005	11.4	0.006	0.3	0.01	0.015	21	0.1	0.52	46	27.1	27.7	0.318	0.11	1.95	0.109	0.110	0.002	0.01	1	0.36	0.3	7.6
	90th Perc.	3	21	0.08	0.08	0.19	0.008	0.005	14.1	0.009	0.3	0.01	0.017	35	0.1	0.62	64	28.1	28.0	0.450	0.13	5.61	0.126	0.128	0.003	0.02	1	0.52	0.4	7.7
	St. Dev.	1	8	0.03	0.03	0.03	0.002	0.001	2.8	0.004	0.0	0.00	0.002	13	0.0	0.11	19	1.6	0.3	0.128	0.02	4.04	0.026	0.026	0.000	0.01	0	0.15	0.2	0.1
Site 3	Number	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
2008	Min	7	4	0.05	0.05	0.09	0.005	0.004	46.1	0.005	0.3	0.01	0.030	4	0.2	0.95	131	15.0	15.1	0.650	0.02	0.23	0.017	0.019	0.002	0.01	1	0.50	0.1	7.1
Fall	Max	11	47	0.10	0.10	0.30	0.015	0.013	161.0	0.005	0.5	0.01	0.113	47	0.4	2.10	208	21.8	21.9	1.900	0.23	0.55	0.219	0.226	0.007	0.05	8	3.80	0.5	7.6
	Mean	8	16	0.08	0.08	0.18	0.008	0.007	98.1	0.005	0.3	0.01	0.053	16	0.3	1.34	160	18.7	19.0	1.458	0.10	0.32	0.099	0.102	0.004	0.02	2	1.54	0.3	7.4
	90th Perc.	10	33	0.10	0.10	0.27	0.013	0.011	148.2	0.005	0.4	0.01	0.085	33	0.4	1.86	189	21.6	21.3	1.852	0.21	0.47	0.206	0.211	0.006	0.04	5	2.92	0.5	7.6
	St. Dev.	1	18	0.02	0.02	0.09	0.004	0.004	50.6	0.000	0.1	0.00	0.034	18	0.1	0.48	29	3.0	2.6	0.504	0.10	0.14	0.096	0.098	0.002	0.02	3	1.33	0.2	0.2

Table 15. Summary data from Site 4, Little Oyster River for 2002, 2003 and 2008.

Site, Sampling Period		Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N. Kjel:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P-T (mg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)	
Site 4	Number		5			5	5	5	5	5	5	5	5	5	5	5				5		5		5		5	5	5	5	5	5
2002	Min		3			0.33	0.016	0.011	15.1	0.005	0.7	0.01	0.005	3	0.2	1.23				62.400		0.10		0.046		0.07	2	3.67	0.8	7.7	
Summer	Max		76			0.39	0.023	0.016	19.1	0.007	0.7	0.03	0.182	180	0.2	1.51				115.000		0.22		0.078		0.15	4	4.02	1.6	7.8	
	Mean		24			0.36	0.021	0.013	17.7	0.005	0.7	0.01	0.100	47	0.2	1.38				82.280		0.15		0.059		0.12	3	3.92	1.2	7.7	
	90th Perc.		54			0.39	0.023	0.015	19.1	0.006	0.7	0.02	0.169	121	0.2	1.48				107.360		0.20		0.071		0.15	4	4.02	1.6	7.8	
	St. Dev.		30			0.02	0.003	0.002	1.8	0.001	0.0	0.01	0.069	75	0.0	0.11				22.686		0.05		0.012		0.03	1	0.15	0.4	0.0	
Site 4	Number		5			5	5	5	5	5	5	5	5	5	5	5				5		5		5		5	5	5	5	5	5
2002	Min		2			0.25	0.015	0.010	9.7	0.005	0.1	0.01	0.005	5	0.2	0.99				7.900		0.05		0.002		0.12	1	1.68	0.1	7.0	
Fall	Max		32			2.23	0.024	0.016	130.0	0.010	0.6	0.02	0.144	74	0.2	2.56				66.100		0.22		1.570		0.80	9	4.29	3.3	7.5	
	Mean		12			0.84	0.019	0.012	65.3	0.006	0.4	0.01	0.066	27	0.2	1.68				28.344		0.11		0.457		0.30	3	2.54	1.3	7.2	
	90th Perc.		26			1.70	0.024	0.014	121.2	0.008	0.6	0.02	0.131	60	0.2	2.24				58.020		0.21		1.140		0.57	7	3.74	2.4	7.4	
	St. Dev.		13			0.82	0.004	0.003	54.6	0.002	0.2	0.00	0.062	29	0.0	0.57				26.330		0.08		0.654		0.28	3	1.09	1.2	0.2	
Site 4	Number		5			5	5	5	5	5	5	5	5	5	5	5				5		5		5		5	5	5	5	5	5
2003	Min		22			0.31	0.017	0.008	20.5	0.005	0.7	0.01	0.179	36	0.2	1.34				15.900		0.07		0.027		0.01	1	3.65	0.9	7.6	
Summer	Max		290			0.59	0.026	0.019	25.3	0.035	1.0	0.47	0.320	330	4.1	1.78				56.400		0.33		0.082		0.09	3	4.73	1.8	7.7	
	Mean		108			0.40	0.021	0.013	22.8	0.019	0.9	0.11	0.256	149	1.1	1.51				40.900		0.19		0.054		0.04	2	4.04	1.1	7.7	
	90th Perc.		208			0.51	0.025	0.017	25.1	0.035	1.0	0.29	0.302	254	2.7	1.69				55.920		0.28		0.076		0.07	3	4.44	1.5	7.7	
	St. Dev.		105			0.11	0.003	0.004	2.2	0.015	0.1	0.20	0.051	109	1.7	0.17				16.774		0.09		0.022		0.03	1	0.41	0.4	0.0	

Table 15.Continued....

Site, Sampling Period		Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N.Kjel:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P--T (mg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)
Site 4	Number					5	5	5	5	5	5	5	5		5	5				5		5		5		5	5	5	5	5
2003	Min					0.53	0.024	0.002	95.8	0.005	0.3	0.01	0.075		0.3	1.78				1.870		0.40		0.056		0.05	1	1.28	1.1	6.9
Fall	Max					0.89	0.052	0.038	178.0	0.007	0.4	0.02	0.191		1.3	3.18				8.750		0.54		0.348		0.10	9	5.50	1.8	7.4
	Mean					0.65	0.034	0.019	128.8	0.006	0.4	0.01	0.107		0.7	2.58				4.934		0.45		0.145		0.06	3	3.00	1.4	7.2
	90th Perc.					0.79	0.048	0.034	158.4	0.007	0.4	0.02	0.152		1.0	3.06				7.282		0.52		0.253		0.08	6	4.66	1.7	7.4
	St. Dev.					0.14	0.012	0.014	30.4	0.001	0.1	0.00	0.047		0.4	0.53				2.498		0.06		0.116		0.02	3	1.60	0.3	0.2
Site 4	Number	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
2008	Min	3	4	0.12	0.1	0.17	0.009	0.009	18.1	0.019	0.6	0.01	0.055	7	0.2	1.06	654	42.8	43.1	1.850	0.04	0.21	0.038	0.041	0.002	0.02	2	2.10	0.4	7.4
Summer	Max	7	190	0.23	0.2	0.27	0.027	0.023	33.4	0.029	0.8	0.01	0.172	560	0.4	1.55	837	44.6	46.6	4.860	0.05	0.44	0.045	0.055	0.017	0.05	5	4.70	1.4	7.7
	Mean	4	50	0.17	0.1	0.21	0.020	0.018	22.7	0.023	0.7	0.01	0.132	135	0.3	1.29	758	43.9	44.6	2.932	0.04	0.33	0.040	0.046	0.006	0.03	3	3.28	0.8	7.6
	90th Perc.	6	125	0.21	0.2	0.25	0.026	0.023	29.2	0.027	0.8	0.01	0.172	355	0.4	1.49	828	44.5	46.4	4.308	0.05	0.41	0.043	0.052	0.012	0.04	5	4.38	1.2	7.7
	St. Dev.	1	79	0.04	0.0	0.04	0.007	0.006	6.3	0.004	0.1	0.00	0.050	238	0.1	0.20	83	0.8	1.6	1.266	0.01	0.09	0.003	0.006	0.006	0.01	1	1.12	0.4	0.1
Site 4	Number	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
2008	Min	8	1	0.12	0.1	0.25	0.021	0.010	54.8	0.005	0.4	0.01	0.054	1	0.4	1.46	339	16.9	17.1	1.410	0.00	0.32	0.002	0.002	0.002	0.05	1	1.70	0.5	7.2
Fall	Max	14	61	0.39	0.4	0.52	0.071	0.066	159.0	0.005	0.7	0.01	0.143	64	0.8	4.13	750	30.6	32.5	3.090	0.24	0.74	0.236	0.241	0.005	0.20	8	8.20	2.2	7.7
	Mean	11	17	0.26	0.3	0.34	0.041	0.034	109.4	0.005	0.6	0.01	0.094	20	0.6	2.48	627	27.2	27.3	2.206	0.08	0.53	0.078	0.081	0.003	0.10	3	3.70	1.0	7.5
	90th Perc.	13	41	0.35	0.4	0.46	0.064	0.060	151.8	0.005	0.7	0.01	0.129	47	0.8	3.66	741	30.5	31.7	2.910	0.20	0.69	0.192	0.197	0.005	0.18	6	6.28	1.7	7.7
	St. Dev.	2	25	0.10	0.1	0.11	0.021	0.024	42.9	0.000	0.1	0.00	0.034	26	0.2	1.08	167	5.8	6.0	0.677	0.10	0.17	0.102	0.104	0.001	0.07	3	2.59	0.7	0.2

Table 16. Raw data from Site 1, Oyster River upstream of Woodhus Creek and Little Oyster River for 2001, 2002, 2003 and 2008.

Site	Sampling Date	Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N.Kjel:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P-T (µg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)
1	2001-10-16		2																				<0.028	0.03	<0.002		<5	0.3		7.36
1	2001-10-23		23																				<0.038	0.04	<0.002		<5	1.3		6.87
1	2001-10-31		5																				<0.029	0.031	<0.002		<5	1		7.22
1	2001-11-06		2																				<0.024	0.026	<0.002		<5	0.5		6.34
1	2001-11-14		3																				<0.022	0.024	<0.002		10	5.05		7.17
1	2002-08-14		<1			0.07	2	<0.002	10.3	<0.005	0.2	<0.01	<0.005	1	<0.2	0.32				0.093		<0.05		0.036		0.1	<1	0.14	0.1	7.6
1	2002-08-18		2			0.06	<2	0.002	10.7	<0.005	0.2	<0.01	<0.005	3	<0.2	0.4				0.412		<0.05		0.07		0.11	<1	0.35	<0.1	7.6
1	2002-08-25		5			0.08	<2	0.002	9.7	<0.005	0.3	0.06	<0.005	5	<0.2	2.71				0.186		<0.05		0.052		0.12	<1	0.16	1.9	7.6
1	2002-09-02		9			0.08	<2	0.002	8.9	<0.005	0.3	<0.01	<0.005	17	<0.2	0.39				0.274		<0.05		0.047		0.04	3	0.14	<0.1	7.6
1	2002-09-08		25			0.1	<2	0.002	7.1	<0.005	0.2	<0.01	<0.005	36	<0.2	1.29				0.244		<0.05		0.061		0.08	<4	0.18	0.1	7.6
1	2002-10-27		1			0.12	<2	<0.002	4.9	0.006	0.3	0.04	<0.005	3	<0.2	0.94				0.519		0.19		0.071		0.15	<1	0.3	0.7	7.3
1	2002-11-03		1			0.11	4	0.004	2.3	<0.005	0.3	<0.01	<0.005	2	<0.2	0.64				0.361		<0.05		0.079		0.14	2	0.27	<0.1	7.3
1	2002-11-10		4			0.19	8	0.005	39.7	<0.005	0.2	<0.01	<0.005	7	<0.2	1.52				0.615		<0.05		0.075		0.13	1	0.95	0.2	7.1
1	2002-11-17		4			0.12	6	0.007	51.8	<0.005	0.2	<0.01	0.049	9	<0.2	1.55				0.715		<0.05		0.021		0.09	5	3.56	0.1	7.6
1	2002-11-24		3			0.08	7	0.002	28.2	0.006	<0.1	<0.01	<0.005	5	<0.2	0.91				0.336		<0.05		0.02		0.09	1	0.53	0.1	7.2
1	2003-08-04		1			0.05	<2	<0.002	11	<0.005	0.4	0.01	0.032	1	<0.2	0.61				0.228		<0.05		0.032		<0.01	<1	0.19	0.1	7.4
1	2003-08-10		17			0.03	4	0.003	11.4	<0.005	0.3	<0.01	0.006	16	<0.2	0.6				0.022		<0.05		0.037		<0.01	1	0.15	0.2	7.5
1	2003-08-17		3			0.05	<2	<0.002	9.2	<0.005	0.2	<0.01	0.02	2	<0.2	0.55				0.221		<0.05		0.035		<0.01	<1	0.19	0.2	7.6
1	2003-08-24		150			0.08	<2	<0.002	6.3	0.025	0.3	0.01	0.017	200	<0.2	0.55				0.18		<0.05		0.036		<0.01	<1	0.24	1.2	7.6
1	2003-09-01		2			0.09	<2	<0.002	7.5	<0.005	0.2	<0.01	<0.005	2	0.2	0.52				0.2		<0.05		0.087		<0.01	<1	0.13	0.2	7.6
1	2003-10-19					0.11	22	0.003	63.2	<0.005	0.3	<0.01	0.126		<0.2	2.12				2.16		0.32		0.012		0.02	25	13.7	0.6	7.2
1	2003-10-26					0.05	6	<0.002	26.5	<0.005	0.2	<0.01	0.025		0.9	0.79				0.563		<0.05		0.016		<0.01	2	1.13	0.3	7.4
1	2003-11-02					0.07	9	0.008	17.8	<0.005	<0.1	<0.01	0.011		<0.2	0.64				0.362		0.08		0.024		<0.01	<1	0.25	0.7	7.3
1	2003-11-11					0.07	<2	<0.002	12.9	0.005	0.2	<0.01	0.005		<0.2	0.52				0.213		<0.05		0.04		<0.01	<1	0.27	0.1	7.5
1	2003-11-16					0.14	<2	<0.002	21	<0.005	0.2	<0.01	0.012		0.3	0.78				0.473		0.1		0.036		<0.01	<1	0.43	0.2	7.4

Table 16. Continued...

Site	Sampling Date	Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N. Kjel:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P-T (µg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)
1	2008-08-10	2.4	5	0.03	0.03	0.07	4	0.003	10.9	<0.005	0.25	<0.005	0.009	6	<0.1	0.36	1	15.3	15	0.2	0.04	0.18	0.04	0.04	<0.002	<0.005	<1	0.4	0.2	7.3
1	2008-08-17	1.2	2	0.06	0.05	0.09	2	<0.002	16.6	<0.005	0.29	<0.005	0.019	2	<0.1	0.57	3	15.6	15.5	0.27	0.03	0.07	0.03	0.03	<0.002	0.038	<1	0.3	0.4	7.4
1	2008-08-24	<0.5	3	0.05	0.05	0.08	2	0.002	10.4	<0.005	0.3	<0.005	0.009	3	<0.1	0.46	4	15.8	15.6	0.13	0.03	0.05	0.031	0.031	<0.002	<0.005	<1	0.4	<0.1	7.5
1	2008-09-01	1	<1	<0.02	<0.02	0.06	3	<0.002	10.8	<0.005	0.26	<0.005	0.009	1	<0.1	0.42	4	14.6	15.6	0.2	<0.04	0.07	0.036	0.036	<0.002	<0.005	<1	0.4	<0.1	7.7
1	2008-09-07	0.7	2	0.04	0.04	0.1	6	0.002	9.4	<0.005	0.27	<0.005	0.009	2	<0.1	0.45	2	16.1	16	0.27	0.06	0.05	0.056	0.056	<0.002	<0.005	<1	0.2	<0.1	7.6
1	2008-10-14	3.6	1	0.05	0.05	0.06	5	0.004	19.1	<0.005	0.28	<0.005	0.018	2	<0.1	0.73	15	14.3	14.8	0.33	0.006	0.09	0.006	0.006	<0.002	0.012	26	0.3	0.1	7.4
1	2008-10-19	4.2	1	0.03	0.03	0.05	4	0.004	39.1	<0.005	0.27	<0.005	0.028	1	0.1	0.95	10	14.2	14.6	0.28	0.02	0.09	0.018	0.018	<0.002	0.025	2	0.5	0.1	7.5
1	2008-10-26	3.5	7	<0.02	<0.02	0.05	4	0.003	16.4		0.28	<0.005	0.013	9	0.2	0.59	6	15.8	15	0.2	<0.03	0.08	0.027	0.027	<0.002	<0.005	2	0.3	0.1	7.6
1	2008-11-02	3.9	14	0.04	0.04	0.07	9	0.008	91	<0.005	0.36	<0.005	0.134	17	0.3	2.34	46	11.9	12.1	1.23	0.03	0.36	0.021	0.023	0.002	0.02	7	4.1	0.4	7.2
1	2008-11-11	2.3	<1	0.09	0.09	0.1	3	0.003	44.7	<0.005	0.22	<0.005	0.033	1	0.1	1.07	20	13	12.2	0.48	0.01	0.11	0.012	0.012	<0.002	0.011	1	0.9	0.2	7.4

Table 17. Raw data from Site 2, Oyster River downstream of Woodhus Creek and Little Oyster River for 2001, 2002, 2003 and 2008.

Site	Sampling Date	Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N.Kjel:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P--T (µg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)
2	2001-10-16		10							<0.005													<0.002	0.004	<0.002		<5	0.43		7.48
2	2001-10-23		140							0.026													<0.017	0.019	<0.002		9	3.6		7.22
2	2001-10-30		10							0.005													<0.049	0.051	<0.002		<5	0.58		7.44
2	2001-11-06		12							<0.005													<0.028	0.03	<0.002		<5	0.53		7.59
2	2001-11-13		18							0.006													<0.026	0.028	<0.002		11	3.8		7.35
2	2001-11-20		31							<0.005													0.126	0.128	0.002		35	12		7.26
2	2002-08-14	0.6	1			0.06	3		10	<0.005	0.2		<0.005	1	<0.2	0.27				0.911		<0.05		0.031		0.07	2	0.24	<0.1	7.6
2	2002-08-18	0.7	13			0.06	2		8.9	<0.005	0.2		<0.005	15	<0.2	0.58				1.41		<0.05		0.035		0.12	<1	0.49	<0.1	7.6
2	2002-08-25	0.8	<1			0.09	<2		12.5	<0.005	0.2		<0.005	1	<0.2	0.49				1.56		<0.05		0.035		0.1	<1	0.33	0.3	7.7
2	2002-09-02	0.8	7			0.09	<2		7.8	<0.005	0.2		<0.005	13	<0.2	0.58				1.73		<0.05		0.033		0.06	<1	0.26	<0.1	7.6
2	2002-09-08	0.6	16			0.09	<2		5.8	<0.005	0.2		<0.005	23	<0.2	0.61				1.74		<0.05		0.046		0.11	<1	0.41	0.3	7.6
2	2002-10-27	1.7	8	0.05	<0.1	0.05	<2		3.7	<0.005	0.2		<0.005	10	<0.2	0.68				1.05		<0.05		0.002		0.09	<1	0.22	<0.1	7.3
2	2002-11-03	0.8	<1	0.04	<0.1	0.04	<2		3.4	<0.005	0.2		0.014	1	<0.2	0.63				1.63		<0.05		<0.002		<0.01	<1	0.19	<0.1	7.2
2	2002-11-10	4.2	41	0.14	0.14	0.31	9		45.6	0.005	0.2		<0.005	110	<0.2	1.52				1.74		<0.05		0.16		0.1	2	0.95	0.2	7.3
2	2002-11-17	4.3	5	0.15	0.15	0.26	14		63	<0.005	0.2		0.153	14	0.2	2.3				1.98		0.21		0.113		0.14	10	6.6	0.8	8.8
2	2002-11-24	1.8	1	0.06	<0.1	0.14	3		205	<0.005	<0.1		<0.005	2	<0.2	0.92				1.51		<0.05		0.074		0.07	2	0.68	0.3	7.2
2	2003-08-04		10			0.05	<2		12.7	<0.005	0.4		0.034	20	<0.2	2.38				1.33		0.11		0.022		0.12	<1	0.25	1.6	7.4
2	2003-08-10		1			0.04	6		13.4	<0.005	0.4		0.013	1	<0.2	0.71				0.163		<0.05		0.02		0.02	<1	0.23	0.4	7.6
2	2003-08-17		1			0.06	2		11.1	<0.005	0.2		0.035	13	<0.2	0.94				0.782		0.05		0.012		0.01	<1	0.31	0.6	7.6
2	2003-08-24		5			0.05	<2		6.2	<0.005	0.2		0.024	8	<0.2	0.61				0.753		0.05		0.028		<0.01	<1	0.24	0.2	7.6
2	2003-09-01		<1			0.1	<2		9.3	<0.005	0.2		<0.005	4	<0.2	0.64				1.12		<0.05		0.055		<0.01	<1	0.26	0.2	7.7
2	2003-10-19					0.18	29		80.1	<0.005	0.4		0.389		0.3	4.1				2.87		0.54		0.051		0.08	38	25	1.4	7.2
2	2003-10-26					0.12	6		33.3	<0.005	0.2		0.031		0.9	1.03				1.5		<0.05		0.042		<0.01	<1	1.6	0.3	7.3
2	2003-11-02					0.1	19		21.2	<0.005	<0.1		0.014		<0.2	0.86				1.79		0.14		0.035		0.03	<1	0.46	0.2	7.3
2	2003-11-11					0.12	<2		16.3	<0.005	0.2		0.012		<0.2	0.73				0.592		0.12		0.054		0.02	<1	0.29	<0.1	7.5
2	2003-11-16					0.21	6		30.4	<0.005	0.2		0.052		0.4	1.17				1.32		0.11		0.065		0.03	2	2.47	0.5	7.4

Table 17. Continued...

Site	Sampling Date	Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N. Kjel:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P-T (µg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)
2	2008-08-10	1.9	17	0.03	0.03	0.04	4		12.1	<0.005	0.25		0.012	24	<0.1	0.44	13	16.4	16.8	0.41	0.01	0.03	0.008	0.008	<0.002	<0.005	<1	0.4	0.2	7.3
2	2008-08-17	0.7	6	0.06	0.06	0.08	4		17	<0.005	0.3		0.013	8	<0.1	0.58	20	17.1	16.6	0.41	0.02	0.07	0.02	0.02	<0.002	0.006	<1	0.3	0.2	7.5
2	2008-08-24	<0.5	6	0.06	0.06	0.08	3		9.9	<0.005	0.28		0.012	14	<0.1	0.59	15	16.4	16.6	0.1	0.01	0.1	0.008	0.008	<0.002	0.03	<1	0.2	1.2	7.4
2	2008-09-01	1.3	3	<0.02	<0.02	0.04	<2		7.7	<0.005	0.25		0.015	3	<0.1	0.48	14	14.9	17	0.72	<0.02	0.08	0.024	0.026	0.002	0.076	<1	0.3	0.2	8.1
2	2008-09-07	0.8	1	0.05	0.05	0.07	5		9.6	<0.005	0.23		0.011	2	<0.1	0.45	15	16.9	16.8	0.81	0.02	0.08	0.015	0.019	0.004	<0.005	<1	0.2	<0.1	7.6
2	2008-10-14	2.5	5	0.05	0.05	0.05	3		17.3	<0.005	0.27		0.024	8	<0.1	0.8	34	15.9	16.6	0.94	0	0.09	0.002	0.002	<0.002	0.019	<1	0.4	0.4	7.5
2	2008-10-19	5.2	2	0.09	0.09	0.1	8		34.8	<0.005	0.27		0.027	3	0.1	1.09	33	15.1	15.3	0.51	0.01	0.09	0.011	0.011	<0.002	0.013	<1	0.4	0.2	7.4
2	2008-10-26	4.2	4	0.03	0.03	0.04	5		17	<0.005	0.26		0.016	4	0.1	0.75	29	16.8	16.9	0.42	0.01	0.09	0.016	0.016	<0.002	0.006	<1	0.4	0.1	7.6
2	2008-11-02	5	61	0.06	0.06	0.2	9		103	<0.005	0.41		0.131	69	0.3	2.66	89	12.3	12.7	1.57	0.14	0.32	0.14	0.146	0.006	0.035	16	10.3	0.5	7.1
2	2008-11-11	3.3	8	0.09	0.09	0.16	5		65.8	<0.005	0.25		0.038	10	0.2	1.26	62	14.5	13.9	0.58	0.07	0.15	0.065	0.065	<0.002	0.015	1	1.7	0.3	7.4



Table 18. Raw data from Site 3, Woodhus Creek for 2002, 2003 and 2008.

Site	Sampling Date	Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N.Kjel:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P--T (µg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)
3	2002-08-14		10			0.14	10		7.1	<0.005	0.1		<0.005	15	<0.2	0.16				0.897		<0.05		0.096		0.08	<1	0.23	0.6	7.7
3	2002-08-18		4			0.14	2		5.3	<0.005	0.2		<0.005	7	<0.2	0.34				0.993		<0.05		0.108		0.11	<1	0.17	<0.1	7.7
3	2002-08-25		10			0.12	6		5.4	<0.005	0.2		<0.005	13	<0.2	0.24				0.846		<0.05		0.079		0.08	<1	0.3	0.1	7.9
3	2002-09-02		17			0.11	<2		7.1	<0.005	0.2		<0.005	24	<0.2	0.36				1.29		<0.05		0.055		0.04	<1	0.18	<0.1	7.8
3	2002-09-08		9			0.11	4		4.3	<0.005	0.2		<0.005	14	<0.2	0.56				0.944		<0.05		0.039		0.12	<1	0.91	0.5	7.8
3	2002-10-27		<1			0.08	2		6.4	<0.005	0.5		<0.005	1	<0.2	0.41				5.86		<0.05		0.002		<0.01	<1	0.33	1.7	7.3
3	2002-11-03		<1			0.06	4		7.1	<0.005	0.2		<0.005	2	<0.2	0.58				2.18		<0.05		<0.002		0.04	<1	0.49	<0.1	7.5
3	2002-11-10		18			0.71	17		125	<0.005	0.3		0.015	37	<0.2	1.79				5.74		0.15		0.378		0.14	2	1.8	0.6	7.1
3	2002-11-17		8			0.59	11		131	<0.005	0.2		0.075	10	<0.2	1.45				2.59		0.17		0.284		0.13	2	2.28	0.8	7.2
3	2002-11-24		2			0.38	4		75.9	0.007	<0.1		<0.005	2	<0.2	0.92				3.73		<0.05		0.232		0.07	1	0.61	<0.1	7.2
3	2003-08-04		5			0.12	<2		8.3	0.006	0.3		0.03	4	<0.2	0.46				0.755		<0.05		0.072		<0.01	<1	0.15	0.3	7.7
3	2003-08-10		1500			0.06	5		7.7	0.008	0.4		0.01	1500	<0.2	0.48				0.211		<0.05		0.061		<0.01	3	0.14	0.3	7.8
3	2003-08-17		11			0.14	<2		7.2	<0.005	0.2		0.02	24	<0.2	0.5				0.494		<0.05		0.077		<0.01	<1	0.17	0.2	7.8
3	2003-08-24		8			0.09	<2		4.4	<0.005	0.2		0.027	13	<0.2	0.48				0.431		0.09		0.047		<0.01	<1	0.33	0.3	7.8
3	2003-09-01		1			0.12	<2		3.8	<0.005	0.2		<0.005	3	0.4	0.37				0.457		<0.05		0.054		<0.01	<1	0.15	0.3	7.8
3	2003-10-19					0.46	10		149	<0.005	0.3		0.089		<0.2	1.52				2.39		0.37		0.191		0.04	5	2.9	2.3	7
3	2003-10-26					0.24	7		77.3	<0.005	0.3		0.042		1	1.1				3.09		0.16		0.09		<0.01	<1	0.77	0.3	7.3
3	2003-11-02					0.27	11		55.8	<0.005	<0.1		0.047		0.3	1.03				4.82		0.21		0.117		0.02	<1	0.44	0.4	7.4
3	2003-11-11					0.26	3		33.2	<0.005	0.2		0.045		<0.2	0.75				2.03		0.25		0.142		0.02	<1	0.47	0.3	7.5
3	2003-11-16					0.3	7		62.1	<0.005	0.3		0.049		0.4	0.95				6.84		0.25		0.114		0.02	<1	1.42	0.4	7.3

Table 18. Continued...

Site	Sampling Date	Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N. Kjeh:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P-T (µg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)
3	2008-08-10	3.4	25	<0.02	0.02	0.13	6		10.4	<0.005	0.27		0.012	44	0.1	0.42	36	27.6	27.9	0.25	<0.11	0.08	0.124	0.124	<0.002	<0.005	<1	0.4	0.2	7.4
3	2008-08-17	1.5	14	0.09	0.09	0.2	5		16.2	<0.005	0.29		0.016	16	<0.1	0.7	24	28.5	28	0.51	0.11	0.27	0.104	0.104	<0.002	0.021	<1	0.3	0.5	7.7
3	2008-08-24	0.8	6	0.06	0.06	0.13	8		10.2	0	0.27		0.018	14	0.1	0.5	47	27.6	27.8	0.17	0.07	9.17	0.065	0.067	0.002	0.006	<1	0.3	0.1	7.6
3	2008-09-01	2.3	16	0.02	<0.02	0.15	5		11	0.009	0.26		0.014	21	0.1	0.46	76	24.3	27.3	0.3	0.13	0.12	0.126	0.126	<0.002	0.008	<1	0.6	0.2	7.7
3	2008-09-07	1.6	4	0.04	0.03	0.17	8		9	0.009	0.25		0.013	11	0.1	0.5	45	27.5	27.4	0.36	0.13	0.11	0.126	0.129	0.003	0.009	<1	0.2	0.3	7.7
3	2008-10-14	7	4	0.1	0.1	0.12	5		46.1	<0.005	0.32		0.037	4	0.2	1.01	160	21.8	21.9	1.78	0.019	0.25	0.017	0.019	0.002	0.015	<1	0.7	0.2	7.6
3	2008-10-19	10.5	6	0.1	0.1	0.15	9		107	<0.005	0.36		0.044	7	0.3	1.51	150	19.2	19.5	1.3	0.05	0.24	0.038	0.043	0.005	0.027	<1	1.1	0.4	7.4
3	2008-10-26	7.1	8	0.06	0.06	0.09	6		47.5	<0.005	0.3		0.03	8	0.2	0.95	153	21.2	20.5	0.65	0.03	0.35	0.033	0.033	<0.002	0.007	<1	0.5	0.1	7.6
3	2008-11-02	9.2	47	0.07	0.07	0.3	15		161	<0.005	0.45		0.113	47	0.4	2.1	208	16.4	18	1.9	0.23	0.55	0.219	0.226	0.007	0.047	8	3.8	0.5	7.1
3	2008-11-11	8.2	13	0.05	0.05	0.23	6		129	<0.005	0.28		0.041	13	0.3	1.13	131	15	15.1	1.66	0.189	0.23	0.186	0.189	0.003	0.02	<1	1.6	0.3	7.3

Table 19. Raw data from Site 4, Little Oyster River for 2002, 2003 and 2008.

Site	Sampling Date	Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N.Kjel:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P--T (µg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)
4	2002-08-14		22			0.35	23		16.6	<0.005	0.7		<0.005	32	<0.2	1.23				62.4		0.18		0.078		0.12	2	4	0.8	7.7
4	2002-08-18		3			0.38	23		19.1	0.007	0.7		0.182	3	<0.2	1.51				95.9		0.22		0.06		0.15	3	3.67	1.1	7.7
4	2002-08-25		4			0.33	19		18.6	<0.005	0.7		0.074	4	<0.2	1.4				74.4		0.13		0.059		0.14	2	3.88	1.6	7.7
4	2002-09-02		76			0.39	23		19	0.005	0.7		0.15	180	<0.2	1.43				115		0.12		0.05		0.07	3	4.02	0.8	7.7
4	2002-09-08		14			0.35	16		15.1	<0.005	0.7		0.089	17	<0.2	1.31				63.7		0.1		0.046		0.14	<4	4.01	1.5	7.8
4	2002-10-27		2			0.25	15		9.7	0.005	0.5		0.061	5	<0.2	0.99				45.9		0.05		0.005		0.8	1	2.01	0.9	7.2
4	2002-11-03		2			0.25	16		12	<0.005	0.6		0.112	6	<0.2	1.44				66.1		0.19		0.002		0.2	2	1.68	<0.1	7.5
4	2002-11-10		32			2.23	24		66.8	<0.005	0.5		0.008	74	<0.2	1.65				13.5		0.06		1.57		0.17	3	2.92	1.1	7.1
4	2002-11-17		18			0.9	23		108	0.005	0.2		0.144	39	0.2	2.56				8.32		0.22		0.494		0.22	9	4.29	3.3	7
4	2002-11-24		5			0.56	17		130	0.01	<0.1		<0.005	13	<0.2	1.76				7.9		<0.05		0.215		0.12	2	1.79	1.1	7.1
4	2003-08-04		290			0.4	23		25.3	0.034	1		0.32	330	4.1	1.78				15.9		0.2		0.082		0.09	3	4.73	1.8	7.6
4	2003-08-10		69			0.59	26		24.9	0.035	1		0.248	140	<0.2	1.46				33.8		0.07		0.068		0.02	1	4.01	0.9	7.7
4	2003-08-17		86			0.31	19		22.1	0.005	0.9		0.255	130	0.2	1.42				43.2		0.2		0.055		0.03	3	3.65	0.9	7.7
4	2003-08-24		72			0.34	21		21.3	<0.005	0.9		0.276	110	0.2	1.55				55.2		0.33		0.027		0.03	2	3.93	1	7.7
4	2003-09-01		22			0.34	17		20.5	0.015	0.7		0.179	36	0.6	1.34				56.4		0.16		0.039		0.01	3	3.86	0.9	7.7
4	2003-10-19					0.89	24		129	0.006	0.4		0.191		0.3	2.52				3.94		0.4		0.348		0.1	9	5.5	1.8	6.9
4	2003-10-26					0.59	52		115	<0.005	0.4		0.094		1.3	2.51				5.03		0.43		0.111		0.05	2	2.75	1.5	7.3
4	2003-11-02					0.53	41		126	<0.005	0.3		0.089		0.6	2.89				8.75		0.48		0.056		0.05	<1	1.28	1.1	7.2
4	2003-11-11					0.63	29		178	0.006	0.4		0.086		0.5	3.18				1.87		0.54		0.1		0.06	2	3.39	1.4	7.4
4	2003-11-16					0.59	24		95.8	0.007	0.3		0.075		0.6	1.78				5.08		0.41		0.109		0.06	<1	2.07	1.2	7.3

Table 19. Continued...

Site	Sampling Date	Carbon Dissolved Organic (mg/L)	E Coli (CFU/100mL)	N. Kjel:T (mg/L)	Nitrogen Organic-Total (mg/L)	Nitrogen Total (mg/L)	P-T (µg/L)	Phosphorus Tot. Dissolved (mg/L)	Al-D (µg/L)	Ammonia:T (mg/L)	As-T (µg/L)	Cd-T (µg/L)	Co-T (µg/L)	Coli:Fec (CFU/100mL)	Cr-T (µg/L)	Cu-T (µg/L)	Fe-D (µg/L)	Hardness Total (D) (mg/L)	Hardness Total (T) (mg/L)	Mn-D (µg/L)	NO2+NO3 (mg/L)	Ni-T (µg/L)	Nitrate (NO3) Dissolved (mg/L)	Nitrate + Nitrite Diss. (mg/L)	Nitrogen - Nitrite Diss. (mg/L)	Pb-T (µg/L)	Residue Non-filterable (mg/L)	Turbidit (NTU)	Zn-T (µg/L)	pH (pH units)
4	2008-08-10	6.5	190	0.19	0.17	0.23	27		18.6	0.019	0.7		0.108	560	0.3	1.13	684	44.3	43.4	2.59	0.04	0.29	0.039	0.043	0.004	0.018	4	2.1	0.4	7.4
4	2008-08-17	4.4	15	0.23	0.2	0.27	20		33.4	0.029	0.84		0.171	19	0.3	1.55	814	44.4	44	3.48	0.04	0.35	0.04	0.043	0.003	0.046	3	3.9	0.9	7.7
4	2008-08-24	3.4	28	0.16	0.14	0.21	25		18.1	0.02	0.72		0.172	47	0.4	1.41	654	44.6	46	1.85	0.05	0.44	0.038	0.055	0.017	0.035	5	4.7	0.5	7.5
4	2008-09-01	4	15	0.12	0.1	0.17	21		20.4	0.025	0.68		0.154	41	0.3	1.29	803	43.4	46.6	1.88	0.05	0.37	0.045	0.047	0.002	0.043	3	3.5	1	7.6
4	2008-09-07	4	4	0.14	0.12	0.18	9		23	0.02	0.59		0.055	7	0.2	1.06	837	42.8	43.1	4.86	0.04	0.21	0.038	0.041	0.003	0.015	2	2.2	1.4	7.7
4	2008-10-14	9.8	5	0.25	0.25	0.25	24		79.4	<0.005	0.56		0.108	5	0.5	2.15	691	30.4	30.5	3.09	0	0.62	<0.002	<0.002	0.003	0.073	2	2.7	0.9	7.5
4	2008-10-19	14	7	0.3	0.3	0.33	71		113	<0.005	0.68		0.094	8	0.7	2.96	727	30.6	32.5	2.16	0.03	0.57	0.026	0.029	0.003	0.204	1	2.5	0.7	7.6
4	2008-10-26	10.7	<1	0.24	0.24	0.25	35		54.8	<0.005	0.54		0.054	<1	0.4	1.46	629	30	28.7	1.41	0.01	0.32	0.002	0.004	0.002	0.051	1	1.7	0.5	7.7
4	2008-11-02	11.6	61	0.39	0.39	0.52	53		159	<0.005	0.65		0.143	64	0.7	4.13	750	28	27.9	2.64	0.13	0.74	0.126	0.13	0.004	0.137	8	8.2	2.2	7.2
4	2008-11-11	8.1	12	0.12	0.12	0.36	21		141	<0.005	0.35		0.072	22	0.8	1.71	339	16.9	17.1	1.73	0.24	0.41	0.236	0.241	0.005	0.057	3	3.4	0.8	7.3