Exhibit F

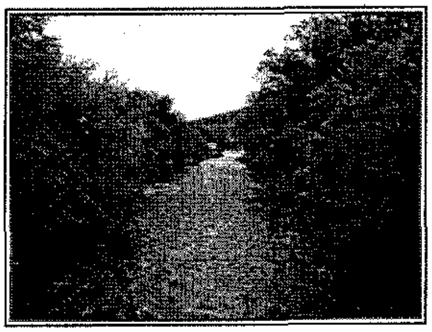
# New Hampshire Volunteer River Assessment Program

## 2002

## ASHUELOT RIVER

## Water Quality Report



NEW HAMPSHIRE DEPARTMENT OF Environmental Services

June 2003

## 3.6. Bacteria

Organisms causing infections or disease (pathogens) are often excreted in the fecal material of humans and other warm-blooded animals. *Escherichia coli* (*E. coli*) bacteria is not considered pathogenic. *E. coli* is, however, almost universally found in the intestinal tracts of humans and warm blooded animals and is relatively easy and inexpensive to measure. For these reasons *E. coli* is used as an indicator of fecal pollution and the possible presence of pathogenic organisms.

In fresh water, *E. coli* concentrations help determine if the water is safe for recreational uses such as swimming. According New Hampshire's surface water quality standards, Class B waters shall contain not more than either a geometric mean based on at least three samples obtained over a sixty-day period of 126 *E. coli* per one hundred milliliters (CTS/100mL), or greater than 406 *E. coli* CTS/100mL in any one sample.

## 3.7. Total Phosphorus

Phosphorus is a nutrient that is essential to plants and animals, however, in excess amounts it can cause rapid increases in the biological activity in water. This may disrupt the ecological integrity of streams and rivers.

Phosphate is the form of phosphorus that is readily available for use by aquatic plants. Phosphate is usually the limiting nutrient in freshwater streams, which means relatively small amounts of phosphate can have a large impact the biological activity in the water. Excess phosphorus can trigger nuisance algal blooms and aquatic plant growth, which can decrease oxygen levels and the attractiveness of waters for recreational purposes.

Phosphorus can be an indicator of sewage, animal manure, fertilizer, erosion, and other types of contamination. There is no surface water quality standard for phosphorus due to the high degree of natural variability and the difficulty of pinpointing the exact source. However 0.05 mg/L total phosphorus is typically used as a level of concern, which means DES pays particular attention to readings above this level.

## 3.8. Metals

Depending on the metal concentration, its form (dissolved or particulate) and the hardness of the water, trace metals can be toxic to aquatic life. Metals in dissolved form are generally more toxic than metals in the particulate form. The dissolved metal concentration is dependent on the pH of the water, as well as the presence of solids and organic matter that can bind with the metal to render it less toxic. Hardness is primarily a measure of the calcium and magnesium ion concentrations in water, expressed as calcium carbonate. The hardness concentration affects the toxicity of certain metals. Numeric criteria for metals may be found in New Hampshire's Surface Water Quality Regulations (Env-Ws 1700).

# 2001 ASHUELOT RIVER RAW DATA

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.
**Metal standards represent fresh water acute criteria.

**2001 VRAP Ashuelot River Baseline Parameters**
**28-Ash, Route 31, Washington, NH**

| Date | Weather | Time of Sample | Turbidity (NTUs) | pH | $H_2O$ Temp. (°C) | DO (mg/L) | DO (% sat.) | Air Temp. (°C) | Conductivity (µmho/cm) | Observed H20 Use |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <10 NTU above background | 6.5-8.0 | Narrative | >5.0 | >75 | NA | NA | NA |
| 5/19/2001 | C | 09:25am | 0.35 | 6.58 | 13.3 | 9.4 | | 13.7 | 22.1 | Kayaks |
| 5/19/2001 | C | 09:25am | 0.35 | 6.58 | 13.3 | 9.4 | | 13.7 | 22.1 | Kayaks |
| 5/19/2001 | C | 09:25am | 0.35 | 6.58 | 13.3 | 9.4 | | 13.7 | 22.1 | Kayaks |
| 6/16/2001 | | 08:52am | 0.3 | 5.73 | 23.9 | 8.7 | | 23.3 | 23 | None |
| 7/14/2001 | C | 08:26am | 0 | 5.9 | 19.7 | 7.8 | | 19.5 | 24.8 | None |
| 7/31/2001 | | 08:25am | | 6.03 | 19.1 | 8.2 | | 18.7 | 25.9 | None |
| 8/18/2001 | C | 08:28am | | 5.76 | 19.2 | 5.4 | | 19 | 34.8 | None |

**2001 VRAP Ashuelot River Additional Parameters**
**28-Ash, Route 31, Washington, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) | Cadmium (ug/L) | Copper (ug/L) | Lead (ug/L) | Zinc (ug/L) | Chlorides (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <126 | NA | <0.95 | <3.6 | <14 | <36.2 | <860,000 |
| 5/19/2001 | C | 09:25am | <10 | 4.6 | 0.006 | <0.25 | 2.51 | <0.5 | <9 | 5 |
| 5/19/2001 | C | 09:25am | <10 | | 0.006 | <0.25 | 2.51 | <0.5 | <9 | |
| 5/19/2001 | C | 09:25am | <10 | | 0.006 | <0.25 | 2.51 | <0.5 | <9 | |
| 6/16/2001 | | 08:52am | 1 | 8.2 | 0.008 | <0.25 | 6.21 | <1.0 | 10 | 5 |
| 7/14/2001 | C | 08:26am | 10 | | 0.008 | <0.25 | <2.5 | <1.0 | <9 | 5 |
| 8/18/2001 | C | 08:28am | 56 | | 0.01 | <0.25 | <2.5 | <1.0 | <9 | 3 |
| 8/18/2001 | C | 08:28am | | | 0.009 | | | | | |

**2001 VRAP Ashuelot River Baseline Parameters**
**27-Ash, Mountain Road, Lempster, NH**

| Date | Weather | Time of Sample | Turbidity (NTUs) | pH | $H_2O$ Temp. (°C) | DO (mg/L) | DO (% sat.) | Air Temp. (°C) | Conductivity (µmho/cm) | Observed H20 Use |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <10 NTU above background | 6.5-8.0 | Narrative | >5.0 | >75 | NA | NA | NA |
| 4/28/2001 | C | 12:13pm | | 5.65 | 6.9 | | | 13.1 | 17.4 | None |
| 5/19/2001 | C | 09:55am | | 5.96 | 12.7 | 9.7 | | 12.9 | 30.1 | None |
| 6/16/2001 | | 09:17am | | 5.47 | 23.5 | 8.3 | | 23.6 | 25 | None |
| 7/14/2001 | C | 08:58am | | 5.79 | 17.7 | 8.8 | | 17.9 | 32.1 | None |
| 7/31/2001 | | 08:54am | | 5.79 | 17.2 | 8.1 | | 18.9 | 34.2 | None |
| 8/18/2001 | C | 09:02am | | 5.66 | 18.2 | 6.5 | | 18.4 | 31.3 | None |

**2001 VRAP Ashuelot River Baseline Parameters**
**24a-Ash, Route 10, Marlow, NH**

| Date | Weather | Time of Sample | Turbidity (NTUs) | pH | $H_2O$ Temp. (°C) | DO (mg/L) | DO (% sat.) | Air Temp. (°C) | Conductivity (μmho/cm) | Observed H20 Use |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <10 NTU above background | 6.5-8.0 | *Narrative* | >5.0 | >75 | NA | NA | NA |
| 4/28/2001 | C | 11:37am | | 5.74 | 7.5 | | | 14.5 | 20.1 | None |
| 5/19/2001 | C | 10:27am | 0.7 | 6.08 | 15 | 10.2 | | 15.2 | 31.6 | none |
| 6/16/2001 | | 09:47am | 0.75 | 5.61 | 25.5 | 8.7 | | 25.4 | 29.2 | none |
| 7/14/2001 | C | 09:29am | 0.5 | 6.06 | 21.3 | 9.2 | | 20.7 | 33.3 | none |
| 7/31/2001 | | 09:52am | | 6.14 | 22.7 | 9 | | 22.4 | 38.6 | None |
| 8/18/2001 | C | 09:31am | | 5.93 | 23.1 | 7.5 | | 22.9 | 43.8 | None |

**2001 VRAP Ashuelot River Additional Parameters**
**24a-Ash, Route 10, Marlow, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) | Cadmium (ug/L) | Copper (ug/L) | Lead (ug/L) | Zinc (ug/L) | Chlorides (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <126 | NA | <0.95 | <3.6 | <14 | <36.2 | <860,000 |
| 5/19/2001 | C | 10:27am | 6 | 8.8 | 0.005 | <0.25 | 2.82 | <0.5 | <9 | 5 |
| 5/19/2001 | C | | | | 0.007 | | | | | |
| 6/16/2001 | | 09:47am | 19 | 8.8 | 0.015 | <0.25 | <2.5 | <1.0 | <9 | 5 |
| 7/14/2001 | C | 09:29am | 6 | | 0.01 | <0.25 | <2.5 | 1.33 | <9 | 5 |
| 8/18/2001 | C | 09:31am | 6 | | 0.011 | <0.25 | 2.5 | <1.0 | <9 | 5 |
| 8/18/2001 | C | 09:31am | | | 0.01 | | | | | |

**2001 VRAP Ashuelot River Baseline Parameters**
**23-Ash, Route 10, Gilsum, NH**

| Date | Weather | Time of Sample | Turbidity (NTUs) | pH | $H_2O$ Temp. (°C) | DO (mg/L) | DO (% sat.) | Air Temp. (°C) | Conductivity (μmho/cm) | Observed H20 Use |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <10 NTU above background | 6.5-8.0 | Narrative | >5.0 | >75 | NA | NA | NA |
| 4/28/2001 | C | 11:17am | | 6.17 | 8.4 | | | 12.1 | 21.6 | None |
| 5/19/2001 | C | 10:47am | 0.4 | 6.51 | 14.8 | 10.1 | | 15.1 | 46.5 | None |
| 6/16/2001 | | 10:11am | 0.45 | 6.16 | 24.4 | 9 | | 25 | 34.2 | None |
| 6/16/2001 | | | 0.55 | 6.53 | 22.3 | | | | 36.7 | |
| 7/14/2001 | C | 10:03am | 0.4 | 6.3 | 17.3 | 9.5 | | 17.5 | 47.6 | None |
| 7/31/2001 | | 10:12am | | 6.55 | 17.4 | 9.5 | | 17.5 | 60.2 | None |
| 8/18/2001 | C | 09:55am | | 6.58 | 19.9 | 8.4 | | 20 | 70.3 | None |

**2001 VRAP Ashuelot River Additional Parameters**
**23-Ash, Route 10, Gilsum, NH**

| Date | Weather | *Time of Sample* | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) | Cadmium (ug/L) | Copper (ug/L) | Lead (ug/L) | Zinc (ug/L) | Chlorides (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <126 | NA | <0.95 | <3.6 | <14 | <36.2 | <860,000 |
| 5/19/2001 | C | 10:47am | 20 | 20.3 | <0.005 | <0.25 | <2.5 | 1.88 | <9 | 10 |
| 6/16/2001 | | 10:11am | 26 | 14.9 | 0.01 | <0.25 | <2.5 | <1.0 | 9 | 5 |
| 6/16/2001 | | | 33 | | | | | | | 5 |
| 7/14/2001 | C | 10:03am | 16 | | 0.011 | <0.25 | <2.5 | 1.43 | <9 | 10 |
| 8/18/2001 | C | 09:55am | 8 | | 0.007 | <0.25 | 2.5 | <1.0 | <9 | 10 |

**2001 VRAP Ashuelot River Baseline Parameters**
**20-Ash, Stone Arch Bridge, Keene, NH**

| Date | Weather | Time of Sample | Turbidity (NTUs) | pH | $H_2O$ Temp. (°C) | DO (mg/L) | DO (% sat.) | Air Temp. (°C) | Conductivity (μmho/cm) | Observed H20 Use |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <10 NTU above background | 6.5-8.0 | Narrative | >5.0 | >75 | NA | NA | NA |
| 4/28/2001 | C | 10:43am | | 6.39 | 8.9 | | | 14.2 | 23.7 | None |
| 5/19/2001 | | 08:15am | 0.65 | 6.21 | 14 | 9.15 | 88.6 | 15 | 64.2 | |
| 5/19/2001 | | 08:15am | 0.6 | | | | | | | |
| 6/16/2001 | O | 07:37am | 0.9 | 5.82 | 22 | 7.59 | 87.4 | 21.5 | 44.6 | None |
| 7/14/2001 | C | 07:36am | 0.5 | 5.55 | 19.3 | 7.9 | | 17 | 60 | |
| 7/31/2001 | | 11:06am | | 6.44 | 22 | 9.3 | | 22 | 69 | None |
| 8/18/2001 | C | 08:40am | | 5.98 | 21.1 | 5.96 | 66.2 | | 90.9 | None |

**2001 VRAP Ashuelot River Additional Parameters**
**20-Ash, Stone Arch Bridge, Keene, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) | Cadmium (ug/L) | Copper (ug/L) | Lead (ug/L) | Zinc (ug/L) | Chlorides (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <126 | NA | <0.95 | <3.6 | <14 | <36.2 | <860,000 |
| 5/19/2001 | | 08:15am | 6 | 17.1 | 0.007 | <0.25 | 2.95 | <0.5 | <9 | 10 |
| 5/19/2001 | | 08:15am | 28 | | | <0.25 | <2.5 | <0.5 | <9 | |
| 6/16/2001 | O | 07:37am | 19 | 39.7 | 0.013 | <0.25 | <2.5 | <1.0 | <9 | 5 |
| 7/14/2001 | C | 07:36am | 44 | | 0.011 | <0.25 | <2.5 | <1.0 | <9 | 10 |
| 8/18/2001 | C | 08:40am | 75 | | 0.013 | <0.25 | <2.5 | <1.0 | <9 | 10 |

**2001 VRAP Ashuelot River Baseline Parameters**
**18-Ash, Route 101, Keene, NH**

| Date | Weather | Time of Sample | Turbidity (NTUs) | pH | $H_2O$ Temp. (°C) | DO (mg/L) | DO (% sat.) | Air Temp. (°C) | Conductivity (μmho/cm) | Observed H20 Use |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <10 NTU above background | 6.5-8.0 | Narrative | >5.0 | >75 | NA | NA | NA |
| 4/28/2001 | C | 10:04am | | 6.54 | 8.5 | | | 10.4 | 26.2 | None |
| 5/19/2001 | | 09:05am | 0.9 | 6.24 | 14 | 8.96 | 87.7 | 17.2 | 83.3 | |
| 6/16/2001 | O | 08:10am | 1 | 6.29 | 22 | 7.67 | 87 | 23 | 52.6 | None |
| 7/14/2001 | C | 08:07am | 0.9 | 6.37 | 19.5 | 8 | | 18 | 101 | |
| 7/31/2001 | | 11:29am | | 6.38 | 21.4 | 8.2 | | 21.7 | 129.9 | None |
| 8/18/2001 | C | 09:07am | | 6.26 | 22.2 | 6.15 | 70.7 | 23.7 | 202.9 | None |

**2001 VRAP Ashuelot River Additional Parameters**
**18-Ash, Route 101, Keene, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) | Cadmium (ug/L) | Copper (ug/L) | Lead (ug/L) | Zinc (ug/L) | Chlorides (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <126 | NA | <0.95 | <3.6 | <14 | <36.2 | <860,000 |
| 5/19/2001 | | 09:05am | | | 0.007 | | | | | 20 |
| 5/19/2001 | | 09:05am | | | | | | | | 20 |
| 6/16/2001 | O | 08:10am | 51 | 171.8 | 0.013 | <0.25 | <2.5 | <1.0 | <9 | 10 |
| 7/14/2001 | C | 08:07am | 92 | | 0.012 | <0.25 | <2.5 | 1.68 | <9 | 20 |
| 8/18/2001 | C | 09:07am | 1080 | | 0.012 | 0.47 | <2.5 | <1.0 | <9 | 40 |

**2001 VRAP Ashuelot River Baseline Parameters**
**16-Ash, Cresson Bridge, Swanzey, NH**

| Date | Weather | Time of Sample | Turbidity (NTUs) | pH | $H_2O$ Temp. (°C) | DO (mg/L) | DO (% sat.) | Air Temp. (°C) | Conductivity (µmho/cm) | Observed H20 Use |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <10 NTU above background | 6.5-8.0 | Narrative | >5.0 | >75 | NA | NA | NA |
| 4/28/2001 | C | 09:42am | | 6.69 | 7.9 | | | 9.3 | 33.1 | None |
| 5/19/2001 | | 09:37am | 0.9 | 6.5 | 14 | 8.75 | 85.3 | 18.5 | 94.3 | |
| 6/16/2001 | O | 09:02am | 1.8 | 6.19 | 22 | 7.3 | 82.5 | 22.4 | 75.2 | None |
| 7/14/2001 | C | 09:06am | 1.9 | 6.2 | 18.2 | 8.4 | | 19 | 117.8 | |
| 7/31/2001 | | 11:52am | | 6.67 | 21.6 | 9.2 | | 21.7 | 148.4 | None |
| 8/18/2001 | C | 09:42am | | 6.32 | 21.5 | 6.21 | 70.8 | 23.4 | 199.6 | None |

**2001 VRAP Ashuelot River Additional Parameters**
**16-Ash, Cresson Bridge, Swanzey, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) | Cadmium (ug/L) | Copper (ug/L) | Lead (ug/L) | Zinc (ug/L) | Chlorides (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <126 | NA | <0.95 | <3.6 | <14 | <36.2 | <860,000 |
| 5/19/2001 | | 09:37am | 33 | 69.8 | 0.051 | <0.25 | <2.5 | <0.5 | <9 | 25 |
| 6/16/2001 | O | 09:02am | 120 | 113 | 0.038 | <0.25 | <2.5 | <1.0 | 11 | 15 |
| 7/14/2001 | C | 09:06am | 86 | | 0.08 | <0.25 | <2.5 | 2.58 | <9 | 25 |
| 8/18/2001 | C | 09:42am | 140 | | 0.154 | <0.25 | <2.5 | <1.0 | <9 | 30 |

**2001 VRAP Ashuelot River Baseline Parameters**
**15-Ash, Thompson Bridge, West Swanzey, NH**

| Date | Weather | Time of Sample | Turbidity (NTUs) | pH | $H_2O$ Temp. (°C) | DO (mg/L) | DO (% sat.) | Air Temp. (°C) | Conductivity (µmho/cm) | Observed H20 Use |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <10 NTU above background | 6.5-8.0 | Narrative | >5.0 | >75 | NA | NA | NA |
| 4/28/2001 | C | 09:27am | | 6.73 | 8.4 | | | 7.5 | 34.5 | None |
| 5/19/2001 | C | 12:29pm | 1.5 | 6.44 | 14.5 | 9 | | 18 | 128.4 | None |
| 6/16/2001 | C | 11:00am | 1.6 | 6.61 | 22.3 | 6.7 | | 23.8 | 69.2 | None |
| 7/14/2001 | C | 11:40am | 2 | 6.63 | 19.8 | 8.3 | | 22 | 120 | |
| 7/31/2001 | | 12:11pm | | 6.72 | 23.7 | 11.5 | | 23.6 | 143.3 | None |
| 8/18/2001 | C | 10:25am | | 6.85 | 22 | 8.1 | | 21.5 | | None |

**2001 VRAP Ashuelot River Additional Parameters**
**15-Ash, Thompson Bridge, West Swanzey, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) | Cadmium (ug/L) | Copper (ug/L) | Lead (ug/L) | Zinc (ug/L) | Chlorides (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <126 | NA | <0.95 | <3.6 | <14 | <36.2 | <860,000 |
| 5/19/2001 | C | 12:29pm | 19 | 46.5 | 0.057 | <0.25 | 6.29 | <0.5 | <9 | 25 |
| 6/16/2001 | C | 11:00am | 61 | 97.8 | 0.039 | <0.25 | 2.77 | <1.0 | 9 | 15 |
| 7/14/2001 | C | 11:40am | 87 | | 0.089 | <0.25 | <2.5 | 2.12 | <9 | 25 |
| 8/18/2001 | C | 10:25am | 176 | | 0.162 | <0.25 | <2.5 | <1.0 | <9 | 35 |

**2001 VRAP Ashuelot River Baseline Parameters**
**07-Ash, Route 119, Winchester, NH**

| Date | Weather | Time of Sample | Turbidity (NTUs) | pH | $H_2O$ Temp. (°C) | DO (mg/L) | DO (% sat.) | Air Temp. (°C) | Conductivity (µmho/cm) | Observed H20 Use |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <10 NTU above background | 6.5-8.0 | Narrative | >5.0 | >75 | NA | NA | NA |
| 4/28/2001 | C | 09:04am | | 6.55 | 8.8 | | | 7.3 | 36 | None |
| 5/19/2001 | C | 11:30am | 1 | 6.34 | 14.3 | 9.7 | | 20.5 | 124.7 | None |
| 6/16/2001 | C | 10:20am | 1.6 | 6.97 | 21.8 | 7 | | 22.8 | 51.7 | None |
| 7/14/2001 | C | 11:00am | 1.3 | 6.63 | 19.8 | 8.4 | | 22 | 110 | |
| 7/31/2001 | | 01:13am | | 7.49 | 24.2 | 12.1 | | 24.2 | 156.1 | None |
| 8/18/2001 | C | 09:45am | | 6.84 | 22.2 | 7.6 | | 22.9 | | None |

**2001 VRAP Ashuelot River Additional Parameters**
**07-Ash, Route 119, Winchester, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) | Cadmium (ug/L) | Copper (ug/L) | Lead (ug/L) | Zinc (ug/L) | Chlorides (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <126 | NA | <0.95 | <3.6 | <14 | <36.2 | <860,000 |
| 5/19/2001 | C | 11:30am | 20 | 35.6 | 0.021 | <0.25 | 4.79 | <0.5 | <9 | 25 |
| 6/16/2001 | C | 10:20am | 47 | 54.1 | 0.031 | <0.25 | <2.5 | <1.0 | 12 | 15 |
| 7/14/2001 | C | 11:00am | 48 | | 0.059 | <0.25 | <2.5 | 2.33 | 12 | 20 |
| 8/18/2001 | C | 09:45am | 70 | | 0.072 | <0.25 | 4.21 | <1.0 | <9 | 25 |

**2001 VRAP Ashuelot River Baseline Parameters**
**01-Ash, 147 River Street, Hinsdale, NH**

| Date | Weather | Time of Sample | Turbidity (NTUs) | pH | $H_2O$ Temp. (°C) | DO (mg/L) | DO (% sat.) | Air Temp. (°C) | Conductivity (µmho/cm) | Observed H20 Use |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <10 NTU above background | 6.5-8.0 | Narrative | >5.0 | >75 | NA | NA | NA |
| 4/28/2001 | C | 08:40am | | 6.65 | 9.3 | | | 7.5 | 36.6 | None |
| 5/19/2001 | C | 10:35am | 0.9 | 6.39 | 14 | 10 | | 16 | 126.6 | Fishing |
| 5/19/2001 | C | 10:40am | | 6.46 | 14.9 | 9.9 | | | | None |
| 6/16/2001 | C | 09:45am | 1.2 | 6.46 | 22 | 8 | | | 54.4 | None |
| 7/14/2001 | C | 09:45am | 1.3 | 7.27 | 19.5 | 9.8 | | 19.5 | 120 | |
| 7/14/2001 | C | 09:50am | 1.3 | | 19.8 | 9.8 | | 19 | | |
| 7/31/2001 | | 12:54pm | | 7.97 | 23.6 | 10.7 | | 23.5 | 146.3 | None |
| 8/18/2001 | C | 08:45am | | 7.38 | 22 | 9.1 | | 21.5 | | None |

**2001 VRAP Ashuelot River Additional Parameters**
**01-Ash, 147 River Street, Hinsdale, NH**

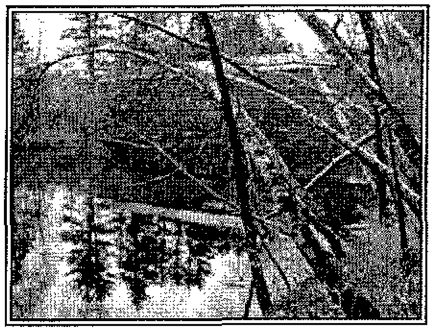
| Date | Weather | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) | Cadmium (ug/L) | Copper (ug/L) | Lead (ug/L) | Zinc (ug/L) | Chlorides (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <126 | NA | <0.95 | <3.6 | <14 | <36.2 | <860,000 |
| 5/19/2001 | C | 10:35am | 51 | 53.3 | 0.018 | <0.25 | <2.5 | <0.5 | <9 | 25 |
| 5/19/2001 | C | 10:40am | 35 | | | | | | | |
| 6/16/2001 | C | 09:45am | 57 | 49.1 | 0.033 | <0.25 | 2.77 | <1.0 | <9 | 15 |
| 7/14/2001 | C | 09:45am | 52 | | 0.056 | <0.25 | <2.5 | 2.57 | <9 | 20 |
| 7/14/2001 | C | 09:50am | 100 | | | <0.25 | <2.5 | 2.2 | <9 | 20 |
| 8/18/2001 | C | 08:45am | 40 | | 0.053 | <0.25 | 2.91 | <1.0 | <9 | 30 |

# New Hampshire Volunteer River Assessment Program

## 2002

## ASHUELOT RIVER

## Water Quality Report

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

June 2003

Table 4-1. Sampling stations and geographic information for the Ashuelot River, DES VRAP, 2002.

| Station ID | Location | Town/City | Calibration Elevation* (feet) |
|---|---|---|---|
| 28-Ash | Route 31 | Washington | 1600 |
| 27-Ash | Mountain Road | Lempster | 1500 |
| 24a-Ash | Route 10 | Marlow | 1100 |
| 23-Ash | Route 10 | Gilsum | 800 |
| 20-Ash | Stone Arch Bridge | Keene | 500 |
| 18-Ash | Route 101 | Keene | 500 |
| 16-Ash | Cresson Bridge | Swanzey | 500 |
| 15-Ash | Thompson Bridge | West Swanzey | 400 |
| 07-Ash | Route 119 | Winchester | 400 |
| 01-Ash | 147 River Street | Hinsdale | 200 |

*Elevations have been rounded off to 100-foot increments for purposes of calibrating the dissolved oxygen meter.

# 5. RESULTS AND DISCUSSION

## 5.1. Dissolved Oxygen

### 5.1.1. Results and Discussion

Five measurements were made in the field for dissolved oxygen (DO) concentration at 10 stations from Washington to Hinsdale (Table 5-1). All measurements met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. The Class B New Hampshire surface water quality standard for DO includes a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be assessed as meeting DO standards.

Table 5-1. Dissolved oxygen data summary for the Ashuelot River, New Hampshire, May-September, 2002, DES VRAP.

| Station ID | Samples Collected | Data Range (mg/l) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2004 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-Ash | 5 | 5.6-10.2 | 0 | 5 |
| 27-Ash | 5 | 7.1-10.4 | 0 | 5 |
| 24a-Ash | 5 | 6.6-10.4 | 0 | 5 |
| 23-Ash | 5 | 8.1-11.0 | 0 | 5 |
| 20-Ash | 5 | 6.0-8.9 | 0 | 5 |
| 18-Ash | 5 | 3.9-8.9 | 1 | 5 |
| 16-Ash | 5 | 5.0-8.5 | 0 | 5 |
| 15-Ash | 5 | 7.5-10.1 | 0 | 5 |
| 07-Ash | 5 | 6.9-10.0 | 0 | 5 |
| 01-Ash | 5 | 8.3-10.8 | 0 | 5 |
| Total dissolved oxygen measurements/samples by Ashuelot group | | | | 50 |

The influence of the urbanized area on the river can be seen by the declining DO concentrations between Gilsum and Keene (Figure 5-1). After traveling through Keene, the river began to experience an increase in DO to a level above the surface water quality standard. DES is currently conducting an intensive DO study along this reach of the river with sampling and computer modeling. Further downstream, DO concentrations at Hinsdale were well above the surface water quality standard, which indicates good oxygen levels entering the Connecticut River.

### 5.1.2. Recommendations

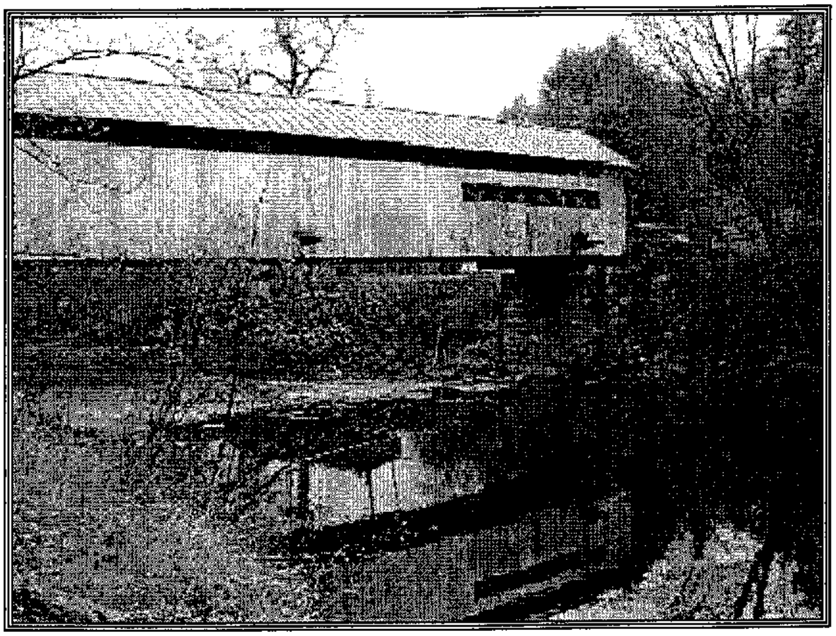
- Continue sampling at all stations; this will be helpful when evaluating the effects of implementing dissolved oxygen enhancements.

**New Hampshire Volunteer River Assessment Program**

**2003**

# ASHUELOT RIVER

# WATER QUALITY REPORT



NEW HAMPSHIRE DEPARTMENT OF Environmental Services

DECEMBER 2003

# 4. MONITORING PROGRAM DESCRIPTION

During the summer of 2001, volunteers from the Ashuelot River Local Advisory Committee began water quality monitoring on the river in conjunction with NHDES's Volunteer River Assessment Program. This effort provides water quality data from the Ashuelot River relative to surface water quality standards. In addition, the ongoing effort allows for an understanding of the river's dynamics, or variations on a station-by-station and year-to-year basis. The data can also serve as a baseline from which to determine any water pollution problems in the river and/or watershed. The Volunteer River Assessment Program has provided field training, equipment, and technical assistance.

Ten stations along the mainstem of the Ashuelot River were monitored in 2003 from its upper limits in Washington to just upstream of its confluence with the Connecticut River in Hinsdale. Sampling station descriptions are provided in Table 4-1 and locations are shown on the foldout map on the following page.

**Table 4-1. Sampling stations for the Ashuelot River, NHDES VRAP, 2003**

| Station ID | Location | Town | Elevation* |
|---|---|---|---|
| 28-ASH | Route 31 | Washington | 1600 |
| 27-ASH | Mountain Road | Lempster | 1500 |
| 24A-ASH | Route 10 | Marlow | 1100 |
| 23-ASH | Route 10 | Gilsum | 800 |
| 20-ASH | Stone Arch Bridge | Keene | 500 |
| 18-ASH | Route 101 | Keene | 500 |
| 16-ASH | Cresson Bridge | Swanzey | 500 |
| 15-ASH | Thompson Bridge | West Swanzey | 400 |
| 07-ASH | Route 119 | Winchester | 400 |
| 01-ASH | 147 River Street | Hinsdale | 200 |

*Elevations have been rounded off to 100-foot increments for purposes of calibrating the dissolved oxygen meter.

# 5. RESULTS AND DISCUSSION

## 5.1. Dissolved Oxygen

### 5.1.1. Results and Discussion

Five measurements were taken in the field for dissolved oxygen concentration at ten stations on the mainstem of the Ashuelot River from Washington to Hinsdale (Table 5-1). Of the 50 measurements taken, 40 met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency.

The Class B New Hampshire surface water quality standard for dissolved oxygen includes a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be assessed as meeting dissolved oxygen standards.

**Table 5-1. Dissolved Oxygen Data Summary for the Ashuelot River 2003, VRAP**

| Station ID | Samples Collected | Data Range (mg/L) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2004 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 5 | 7.22 - 9.70 | 0 | 4[a] |
| 27-ASH | 5 | 7.35 - 11.6 | 0 | 4[a] |
| 24A-ASH | 5 | 7.25 - 9.66 | 0 | 4[a] |
| 23-ASH | 5 | 7.99 – 13.00 | 0 | 4[a] |
| 20-ASH | 5 | 6.33 - 9.58 | 0 | 4[a] |
| 18-ASH | 5 | 6.22 - 9.70 | 0 | 4[a] |
| 16-ASH | 5 | 6.70 - 9.75 | 0 | 4[a] |
| 15-ASH | 5 | 6.43 - 9.57 | 0 | 4[a] |
| 07-ASH | 5 | 7.30 - 9.37 | 0 | 4[a] |
| 01-ASH | 5 | 7.88 - 10.74 | 0 | 4[a] |
| **Total Number of Useable Samples for 2004 NH Surface Water Quality Assessment** | | | | **40** |

[a]Relative % differences of both Rep and Dup exceeded standard in QAPP on 7/26/03

Dissolved oxygen concentration levels were above state standards on all occasions and at all stations [Figure 5-1]. The average concentration of dissolved oxygen was consistently above the Class B standard at all stations ranging from 7.4 mg/L to 9.8 mg/L. Levels of dissolved oxygen sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions.

**New Hampshire Volunteer River Assessment Program**

**2004**

# ASHUELOT RIVER

# WATER QUALITY REPORT

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

FEBRUARY 2005

# 4. MONITORING PROGRAM DESCRIPTION

During the summer of 2001, volunteers from the Ashuelot River Local Advisory Committee began water quality monitoring on the river in conjunction with NHDES's Volunteer River Assessment Program. This effort provides water quality data from the Ashuelot River relative to surface water quality standards. In addition, the ongoing effort allows for an understanding of the river's dynamics, or variations on a station-by-station and year-to-year basis. The data can also serve as a baseline from which to determine any water pollution problems in the river and/or watershed. The Volunteer River Assessment Program has provided field training, funding, equipment, and technical assistance.

Ten stations along the mainstem of the Ashuelot River were monitored in 2004 from its upper limits in Washington to just upstream of its confluence with the Connecticut River in Hinsdale. Sampling station descriptions are provided in Table 4-1 and locations are shown on the foldout map on the following page.

**Table 4-1. Sampling stations for the Ashuelot River, NHDES VRAP, 2004**

| Station ID | Location | Town | Elevation* |
|---|---|---|---|
| 28-ASH | Route 31 | Washington | 1600 |
| 27-ASH | Mountain Road | Lempster | 1500 |
| 24A-ASH | Route 10 | Marlow | 1100 |
| 23-ASH | Route 10 | Gilsum | 800 |
| 20A-ASH | Stone Arch Bridge | Keene | 500 |
| 18-ASH | Route 101 | Keene | 500 |
| 16-ASH | Cresson Bridge | Swanzey | 500 |
| 15-ASH | Thompson Bridge | West Swanzey | 400 |
| 07-ASH | Route 119 | Winchester | 400 |
| 01-ASH | 147 River Street | Hinsdale | 200 |

*Elevations have been rounded off to 100-foot increments for purposes of calibrating the dissolved oxygen meter.

# 5. RESULTS AND DISCUSSION

## 5.1. Dissolved Oxygen

### 5.1.1. Results and Discussion

Five measurements were taken in the field for dissolved oxygen concentration at 10 stations on the mainstem of the Ashuelot River from Washington to Hinsdale [Table 5-1]. Of the 50 measurements taken, 47 met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

The Class B New Hampshire surface water quality standard for dissolved oxygen includes a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be assessed as meeting dissolved oxygen standards.

**Table 5-1. Dissolved Oxygen Data Summary, Ashuelot River 2004, VRAP**

| Station ID | Samples Collected | Data Range (mg/l) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 5 | 6.87 - 8.04 | 0 | 5 |
| 27-ASH | 5 | 7.03 - 8.37 | 0 | 5 |
| 24A-ASH | 5 | 7.38 - 8.16 | 0 | 5 |
| 23-ASH | 5 | 7.87 - 9.22 | 0 | 5 |
| 20A-ASH | 5 | 7.39 - 8.40 | 0 | 5 |
| 18-ASH | 5 | 7.35 - 8.43 | 0 | 5 |
| 16-ASH | 5 | 7.26 - 8.25 | 0 | 5 |
| 15-ASH | 5 | 6.30 - 7.21 | 0 | 4[a] |
| 07-ASH | 5 | 6.96 - 7.40 | 0 | 4[a] |
| 01-ASH | 5 | 7.95 - 8.67 | 0 | 4[a] |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **47** |

**[a]Relative % differences of replicate exceeded standard in QAPP on 5/22/04**

Dissolved oxygen concentration levels were above state standards on all occasions and at all stations (Figure 5-1). The average concentration of dissolved oxygen was consistently above the Class B standard at all stations ranging from 6.9 mg/L to 8.7 mg/L. Levels of dissolved oxygen sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions.

# 2002 ASHUELOT RIVER RAW DATA

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and

**2002 VRAP Ashuelot River Baseline Parameters**
**28-Ash, Route 31, Washington, NH**

| Date | Weather | Time of Sample | DO (mg/L) | DO (% sat.) | $H_2O$ Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) |
|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75 | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd |
| 5/18/2002 | | 7:55 | 10.16 | 93 | | 1.9 | 5.74 | 0 |
| 6/22/2002 | O | 8:10 | 8.18 | 93.1 | 21.7 | 20.3 | 5.69 | 0.2 |
| 7/20/2002 | PC | 8:04 | 7.95 | 90.2 | 21.6 | 17.9 | 6.33 | 0.8 |
| 8/17/2002 | PC | 7:45 | 5.62 | 64.2 | 22 | 20.2 | 6.05 | |
| 9/21/2002 | O | 7:51 | 7.79 | 80.7 | 17.7 | 17.4 | 6.23 | 0.5 |

**2002 VRAP Ashuelot River Additional Parameters**
**28-Ash, Route 31, Washington, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100 mL) | Chlorides (ug/L) | Total Phosphorus (mg/L) | Copper (ug/L) |
|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <860,000 | NA | <3.6 |
| 5/18/2002 | | 7:55 | <1 | 5 | 0.005 | <2.5 |
| 6/22/2002 | O | 8:10 | <1 | <5 | 0.006 | |
| 7/20/2002 | PC | 8:04 | 14 | 5 | | |

**2002 VRAP Ashuelot River Baseline Parameters**
**27-Ash, Mountain Road, Lempster, NH**

| Date | Weather | Time of Sample | DO (mg/L) | DO (% sat.) | $H_2O$ Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) |
|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75 | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd |
| 5/18/2002 | | 8:37 | 10.39 | 92.4 | 10 | 1.6 | 5.59 | 0 |
| 6/22/2002 | O | 9:04 | 8.57 | 94.8 | 20.3 | 22 | 5.69 | 0.15 |
| 7/20/2002 | PC | 9:02 | 8.17 | 89.5 | 19.9 | 21.3 | 5.69 | 0.9 |
| 8/17/2002 | PC | 8:55 | 7.05 | 91.9 | 20.6 | 21.9 | 5.98 | |
| 9/21/2002 | O | 8:52 | 7.76 | 80.6 | 17.2 | 17.7 | 6.16 | 0.85 |

**2002 VRAP Ashuelot River Additional Parameters**
**27-Ash, Mountain Road, Lempster, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100 mL) | Chlorides (ug/L) | Total Phosphorus (mg/L) | Copper (ug/L) |
|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <860,000 | NA | <3.6 |
| 5/18/2002 | | 8:37 | <1 | 0 | 0.006 | <2.5 |
| 6/22/2002 | O | 9:04 | 6 | 5 | 0.007 | |
| 7/20/2002 | PC | | 780* | 5 | | |

*Sampler indicated tha bottle touched bottom

**2002 VRAP Ashuelot River Baseline Parameters**
**24a-Ash, Route 10, Marlow, NH**

| Date | Weather | Time of Sample | DO (mg/L) | DO (% sat.) | $H_2O$ Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) |
|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75 | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd |
| 5/18/2002 | | 9:23 | 10.44 | 95.5 | 11.3 | 3.4 | 5.69 | 0.35 |
| 6/22/2002 | O | 10:07 | 8.27 | 95 | 22.3 | 21 | 5.86 | 0.6 |
| 7/20/2002 | PC | 10:00 | 8.29 | 97.3 | 23.4 | 25 | 6.35 | 0.35 |
| 8/17/2002 | PC | 9:50 | 6.58 | 80.6 | 25.6 | 23 | 6.25 | |
| 9/21/2002 | O | 9:36 | 7.56 | 83.4 | 20.2 | 19.3 | 6.42 | 0.05 |

**2002 VRAP Ashuelot River Additional Parameters**
**24a-Ash, Route 10, Marlow, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100 mL) | Chlorides (ug/L) | Total Phosphorus (mg/L) | Copper (ug/L) |
|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <860,000 | NA | <3.6 |
| 5/18/2002 | | 9:23 | 2 | 5 | 0.007 | <2.5 |
| 6/22/2002 | O | 10:07 | 22 | 5 | 0.008 | |
| 7/20/2002 | PC | 10:00 | 40 | 10 | | |

**2002 VRAP Ashuelot River Baseline Parameters**
**23-Ash, Route 10, Gilsum, NH**

| Date | Weather | Time of Sample | DO (mg/L) | DO (% sat.) | $H_2O$ Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) |
|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75 | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd |
| 5/18/2002 | | 9:54 | 10.96 | 96.4 | 9.6 | 3.8 | 6.18 | 0.25 |
| 6/22/2002 | O | 10:45 | 8.57 | 97.1 | 20.5 | 19.3 | 5.9 | 0.45 |
| 7/20/2002 | PC | 11:00 | 9.17 | 101.7 | 20.4 | 22.2 | 6.88 | 0.95 |
| 8/17/2002 | PC | 10:32 | 8.12 | 94 | 22.5 | 24.5 | 7.03 | |
| 9/21/2002 | O | 10:00 | 9.16 | 98.6 | 18.9 | 19.4 | 6.98 | 0 |

**2002 VRAP Ashuelot River Additional Parameters**
**23-Ash, Route 10, Gilsum, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100 mL) | Chlorides (ug/L) | Total Phosphorus (mg/L) | Copper (ug/L) |
|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <860,000 | NA | <3.6 |
| 5/18/2002 | | 9:54 | 12 | 5 | 0.005 | <2.5 |
| 6/22/2002 | O | 10:45 | 32 | 5 | 0.009 | |
| 7/20/2002 | PC | 11:00 | 200 | 10 | | |

**2002 VRAP Ashuelot River Baseline Parameters**
**20-Ash, Stone Arch Bridge, Keene, NH**

| Date | Weather | Time of Sample | DO (mg/L) | DO (% sat.) | $H_2O$ Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) |
|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75 | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd |
| 5/18/2002 | | 8:07 | 8.94 | 81.6 | 11.4 | 8 | 6.1 | 0.65 |
| 6/22/2002 | O | 10:45 | 8.57 | 97.1 | 20.5 | 19.3 | 5.9 | 0.45 |
| 7/20/2002 | PC | 8:45 | 6.54 | 73.6 | 21 | 20.8 | 6.86 | 0.65 |
| 8/17/2002 | PC | 8:28 | 6.02 | 68.4 | 23 | 21 | 6.65 | |
| 9/21/2002 | O | 9:15 | 7.17 | 78.2 | 19.5 | 20.8 | 6.33 | 0.7 |

**2002 VRAP Ashuelot River Additional Parameters**
**20-Ash, Stone Arch Bridge, Keene, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100 mL) | Chlorides (ug/L) | Total Phosphorus (mg/L) | Copper (ug/L) |
|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <860,000 | NA | <3.6 |
| 5/18/2002 | | 8:07 | 3 | 5 | 0.012 | <2.5 |
| 6/22/2002 | O | 10:45 | 32 | 5 | 0.009 | |
| 7/20/2002 | PC | 8:45 | 107 | 10 | | |

**2002 VRAP Ashuelot River Baseline Parameters**
**18-Ash, Route 101, Keene, NH**

| Date | Weather | Time of Sample | DO (mg/L) | DO (% sat.) | $H_2O$ Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) |
|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75 | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd |
| 5/18/2002 | | 8:53 | 8.91 | 80.1 | 11.1 | 4.3 | 5.58 | 1.1 |
| 6/22/2002 | O | 9:00 | 8.35 | 96.1 | 20.3 | 22.9 | 6.66 | 1 |
| 7/20/2002 | PC | 9:30 | 6.34 | 71.8 | 22 | 21.9 | 6.65 | 1 |
| 8/17/2002 | PC | 9:20 | 3.9 | 45.7 | 24 | 24.8 | 6.52 | |
| 9/21/2002 | O | 10:05 | 6.85 | 75.3 | 19.5 | 21.5 | 6.31 | 1.2 |

**2002 VRAP Ashuelot River Additional Parameters**
**18-Ash, Route 101, Keene, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100 mL) | Chlorides (ug/L) | Total Phosphorus (mg/L) | Copper (ug/L) |
|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <860,000 | NA | <3.6 |
| 5/18/2002 | | 8:53 | 108 | 10 | 0.01 | <2.5 |
| 6/22/2002 | O | 9:00 | 28 | 15 | 0.01 | |
| 7/20/2002 | PC | 9:30 | 410 | 30 | | |

**2002 VRAP Ashuelot River Baseline Parameters**
**16-Ash, Cresson Bridge, Swanzey, NH**

| Date | Weather | Time of Sample | DO (mg/L) | DO (% sat.) | $H_2O$ Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) |
|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75 | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd |
| 5/18/2002 | | 9:40 | 8.54 | 77.6 | 11 | 5.5 | 5.7 | 1 |
| 6/22/2002 | O | 9:45 | 8.07 | 90.5 | 21.1 | 22.7 | 6.64 | 1.6 |
| 7/20/2002 | PC | 10:25 | 6.32 | 71.8 | 21.3 | 24 | 6.83 | 1.6 |
| 8/17/2002 | PC | 10:05 | 4.99 | 58.8 | 24 | 23.3 | 6.29 | |
| 9/21/2002 | O | 11:00 | 7.3 | 79.1 | 19.3 | 21.4 | 6.59 | 1.8 |

**2002 VRAP Ashuelot River Additional Parameters**
**16-Ash, Cresson Bridge, Swanzey, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100 mL) | Chlorides (ug/L) | Total Phosphorus (mg/L) | Copper (ug/L) |
|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <860,000 | NA | <3.6 |
| 5/18/2002 | | 9:40 | 50 | 10 | 0.026 | <2.5 |
| 6/22/2002 | O | 9:45 | 60 | 20 | 0.042 | |
| 7/20/2002 | PC | 10:25 | 920 | 45 | | |

**2002 VRAP Ashuelot River Baseline Parameters**
**15-Ash, Thompson Bridge, West Swanzey, NH**

| Date | Weather | Time of Sample | DO (mg/L) | DO (% sat.) | $H_2O$ Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) |
|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75 | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd |
| 5/18/2002 | | 10:18 | 10.1 | 93.2 | 11.8 | 4.4 | 6.89 | 0.86 |
| 6/22/2002 | O | 11:30 | 7.94 | 88.4 | 20.6 | 20.9 | 6.38 | 1.9 |
| 7/20/2002 | PC | 10:40 | 8.96 | 103.8 | 23 | 24.3 | 6.99 | 1.8 |
| 8/17/2002 | PC | 10:25 | 9.25 | 113.6 | 25.96 | 25.5 | 7.3 | |
| 9/21/2002 | O | 9:55 | 7.5 | 82.9 | 19.8 | 21.2 | 6.9 | 1.4 |

**2002 VRAP Ashuelot River Additional Parameters**
**15-Ash, Thompson Bridge, West Swanzey, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100 mL) | Chlorides (ug/L) | Total Phosphorus (mg/L) | Copper (ug/L) |
|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <860,000 | NA | <3.6 |
| 5/18/2002 | | 10:18 | 22 | 15 | 0.021 | <2.5 |
| 6/22/2002 | O | 11:30 | 117 | 20 | 0.047 | |
| 7/20/2002 | PC | 10:40 | 110 | 40 | | |

**2002 VRAP Ashuelot River Baseline Parameters**
**07-Ash, Route 119, Winchester, NH**

| Date | Weather | Time of Sample | DO (mg/L) | DO (% sat.) | $H_2O$ Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) |
|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75 | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd |
| 5/18/2002 | | 10:01 | 9.98 | 99.1 | 11.5 | 3.2 | 6.45 | 0.85 |
| 6/22/2002 | O | 10:45 | 8.2 | 91.4 | 20.7 | 21.2 | 6.21 | 1.3 |
| 7/20/2002 | PC | 9:45 | 8.04 | 92.5 | 22.2 | 21 | 7.03 | 1.2 |
| 8/17/2002 | PC | 9:40 | 6.94 | 82.6 | 24.1 | 24.2 | 6.84 | |
| 9/21/2002 | O | 9:17 | 8.31 | 92.6 | 20.7 | 20.8 | 7.13 | 0.75 |

**2002 VRAP Ashuelot River Additional Parameters**
**07-Ash, Route 119, Winchester, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100 mL) | Chlorides (ug/L) | Total Phosphorus (mg/L) | Copper (ug/L) |
|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <860,000 | NA | <3.6 |
| 5/18/2002 | | 10:01 | 48 | 10 | 0.025 | <2.5 |
| 6/22/2002 | O | 10:45 | 50 | 15 | 0.034 | |
| 7/20/2002 | PC | 9:45 | 116 | 35 | | |

**2002 VRAP Ashuelot River Baseline Parameters**
**01-Ash, 147 River Street, Hinsdale, NH**

| Date | Weather | Time of Sample | DO (mg/L) | DO (% sat.) | $H_2O$ Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) |
|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75 | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd |
| 5/18/2002 | | 9:05 | 10.76 | 96.4 | 10.6 | 3.3 | 6.62 | 1 |
| 6/22/2002 | O | 9:30 | 8.96 | 99.3 | 20.4 | 21.2 | 6.35 | 1.5 |
| 7/20/2002 | PC | 8:50 | 8.75 | 100.9 | 22.2 | 19.6 | 7.76 | 0.95 |
| 8/17/2002 | PC | 8:45 | 8.27 | 100.5 | 25.2 | 23.8 | 7.42 | |
| 9/21/2002 | O | 8:05 | 8.71 | 96.5 | 20.3 | 19.2 | 7.79 | 0.2 |

**2002 VRAP Ashuelot River Additional Parameters**
**01-Ash, 147 River Street, Hinsdale, NH**

| Date | Weather | Time of Sample | *E. coli* (CTS/100 mL) | Chlorides (ug/L) | Total Phosphorus (mg/L) | Copper (ug/L) |
|---|---|---|---|---|---|---|
| Standard* | NA | NA | <406 | <860,000 | NA | <3.6 |
| 5/18/2002 | | 9:05 | 62 | 10 | 0.025 | <2.5 |
| 6/22/2002 | O | 9:30 | 89 | 20 | 0.027 | |
| 7/20/2002 | PC | 8:50 | 152 | 35 | | |

RSA 485-A:8 for c

| Conductivity (μmho/cm) |
|---|
| NA |
| 28.4 |
| 24.7 |
| 33.8 |
| 38.7 |
| 51.5 |

| Conductivity (μmho/cm) |
|---|
| NA |
| 31.5 |
| 32.4 |
| 43.1 |
| 39.8 |
| 39.7 |

at sample

| Conductivity (μmho/cm) |
|---|
| NA |
| 39.4 |
| 37 |
| 47.3 |
| 51.6 |
| 53.8 |

| Conductivity (μmho/cm) |
|---|
| NA |
| 42.2 |
| 44.9 |
| 22.2 |
| 110.3 |
| 98.8 |

| Conductivity (µmho/cm) |
|---|
| NA |
| 45.9 |
| 44.9 |
| 20.8 |
| 105.7 |
| 94.6 |

| Conductivity (µmho/cm) |
|---|
| NA |
| 56.5 |
| 74 |
| 145.4 |
| 117 |
| 221.7 |

| Conductivity (µmho/cm) |
| --- |
| NA |
| 77.6 |
| 99.1 |
| 195.5 |
| 109.8 |
| 202.6 |

| Conductivity (µmho/cm) |
| --- |
| NA |
| 70.8 |
| 96.8 |
| 204.1 |
| 227.7 |
| 204.8 |

| Conductivity (μmho/cm) |
|---|
| NA |
| 70.7 |
| 92.6 |
| 172.2 |
| 162.3 |
| 219 |

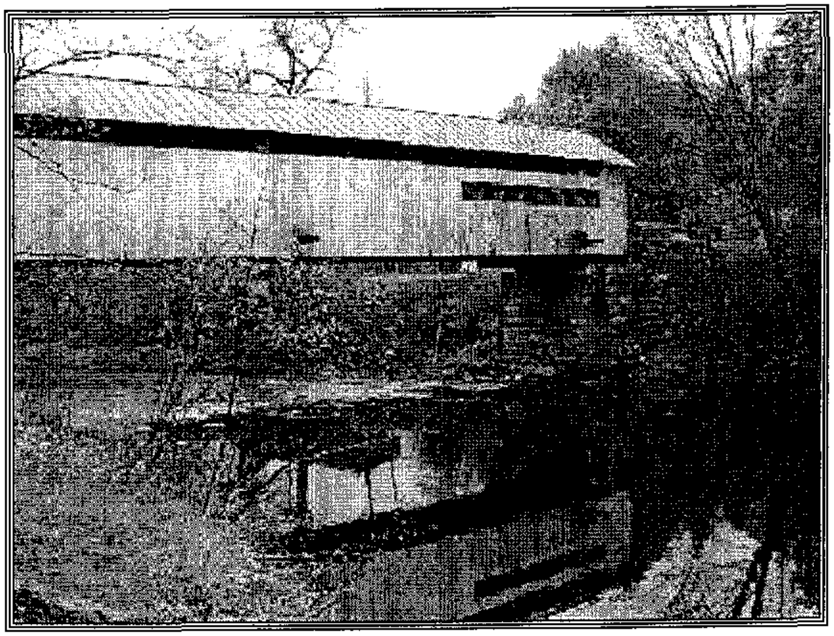
| Conductivity (μmho/cm) |
|---|
| NA |
| 68 |
| 97.8 |
| 168.4 |
| 180.5 |
| 217.4 |

**New Hampshire Volunteer River Assessment Program**

**2003**

**ASHUELOT RIVER**

**WATER QUALITY REPORT**



NEW HAMPSHIRE DEPARTMENT OF Environmental Services

DECEMBER 2003

NHDES-R-WD—3-44

# STATE OF NEW HAMPSHIRE

# Volunteer River Assessment Program

# 2003

# ASHUELOT RIVER

# Water Quality Report

*STATE OF NEW HAMPSHIRE*
*DEPARTMENT OF ENVIRONMENTAL SERVICES*
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December 2003

Printed on Recycled Paper

Cover Photograph: Ashuelot River, Coombs Road Bridge [05-ASH], Winchester

## ACKNOWLEDGEMENTS

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**2003 Ashuelot River Watershed Volunteers**

Barbara Skuly
Jay Smeltz
Andrew Smeltz
Jim Blake
Will Schoefmann
Zack Adams
Pete Funk
Pat Eggleston
Michael Pesa-Fallon
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Al Stoops
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Amy Mayfield
Pablo Fleischmann
Roger Sweet
Ann Sweet
Beth Caldwell
Claire Gogolen

# 1. INTRODUCTION

## 1.1. Purpose of Report

Each year NHDES prepares and distributes a water quality report for each volunteer group that is based solely on the water quality data collected by that volunteer group during a specific year. The reports summarize and interpret the data, particularly as they relate to New Hampshire surface water quality standards, and serve as a teaching tool and guidance document for future monitoring activities by the individual volunteer groups. The purpose of this report is to present the data collected by the Ashuelot River VRAP volunteers in 2003.

## 1.2. Report Format

Each report includes the following:

- ✓ **Volunteers River Assessment Program (VRAP) Overview:** This section includes a discussion of the history of VRAP, the technical support, training and guidance provided by NHDES, and how data is transmitted to the volunteers and used in surface water quality assessments.

- ✓ **Water Quality Parameters Typically Selected for Monitoring**: This section includes a brief discussion of water quality parameters typically sampled by volunteers and their importance, as well as applicable state water quality criteria or levels of concern.

- ✓ **Monitoring Program Description**: A description of the volunteer group's monitoring program is provided in this section including monitoring objectives as well as a table and map showing sample station locations.

- ✓ **Results and Discussion:** Water quality data collected during the year are summarized on a parameter-by-parameter basis using (1) a summary table that includes the number of samples collected, data ranges, the number of samples meeting New Hampshire water quality standards, and the number of samples of adequate assessment quality for each station, (2) a discussion of the data, (3) a list of applicable recommendations, and (4) a river graph showing the range of measured values at each station. Sample results reported as less than the detection limit were assumed equal to one-half the detection limit on the river graphs. This approach simplifies the understanding of the parameter of interest, and specifically helps one to visualize how the river or watershed is functioning from upstream to downstream. In addition, this format allows the reader to better understand potential pollution areas and target those areas for additional sampling or environmental enhancements. Where applicable, the river graph also shows New Hampshire surface water quality standards or levels of concern for comparison purposes.

- ✓ **Appendix – Data:** The appendix includes a spreadsheet showing the data results and additional information such as the time the sample was taken.

# 2. VOLUNTEER RIVER ASSESSMENT PROGRAM OVERVIEW

## 2.1. Past, Present, and Future

In 1998, the New Hampshire Department of Environmental Services (DES) initiated the New Hampshire Volunteer River Assessment Program (VRAP) as a means of expanding public education of water resources in New Hampshire. VRAP promotes education and awareness of the importance of maintaining water quality in rivers and streams. VRAP was created in the wake of the success of the existing New Hampshire Volunteer Lake Assessment Program (VLAP), which provides educational and stewardship opportunities pertaining to lakes and ponds to New Hampshire's residents.

Today, VRAP continues to serve the public by providing water quality monitoring equipment, technical support, and educational programs. VRAP supports over a dozen volunteer groups on numerous rivers and watersheds throughout the state. These volunteer groups conduct water quality monitoring on an ongoing basis. The work of the VRAP volunteers increases the amount of river water quality information available to local, state and federal governments, which allows for effective financial resource allocation and watershed planning.

The intent of VRAP is to educate people of all ages and backgrounds about river and stream water quality, the threats to water quality posed by increasing population, development and industrialization, and the ways in which we can all work together to minimize these impacts.

## 2.2. Technical Support

VRAP lends and maintains water quality monitoring kits to volunteer groups throughout the state. The kits contain electronic meters and supplies for "in-the-field" measurements of water temperature, dissolved oxygen, pH, specific conductance (conductivity), and turbidity. These are the core parameters typically measured by volunteers. However, other water quality parameters, such as nutrients, metals, and *E. coli* can also be studied by volunteer groups, although VRAP does not always provide funds to cover laboratory analysis costs. Thus, VRAP encourages volunteer groups to pursue other fundraising activities such as association membership fees, special events, in-kind services (non-monetary contributions from individuals and organizations), and grant writing.

VRAP typically recommends sampling every other week during the summer, and citizen-monitoring groups are encouraged to organize a long-term sampling program in order to begin to determine trends in river conditions. Each year volunteers arrange a sampling schedule and design in cooperation with the VRAP Coordinator. Project designs are created through a review and discussion of existing water quality information, such as known and perceived problem areas or locations of exceptional water quality. The interests, priorities, and resources of the partnership determine monitoring locations, parameters, and frequency.

Water quality measurements repeated over time create a picture of the fluctuating conditions in rivers and streams and help to determine where improvements, restoration or preservation may benefit the river and the communities it supports. Water quality results are also used to determine if a river is meeting surface water quality standards. Volunteer monitoring results, meeting DES Quality Assurance and Quality Control (QA/QC) requirements, supplement the efforts of DES to assess the condition of New Hampshire surface waters. The New Hampshire Surface Water Quality Regulations are available through the DES Public Information Center at www.des.state.nh.us/wmb/Env-Ws1700.pdf or (603) 271-1975.

## 2.3. Training and Guidance

Each VRAP volunteer must attend an annual training session to receive a demonstration of monitoring protocols and sampling techniques. Training sessions are an opportunity for volunteers to come together and receive an updated version of monitoring techniques. During the training, volunteers have a chance to practice using the VRAP equipment and may also receive instruction in the collection of samples for laboratory analysis. Training is accomplished in approximately three hours, after which volunteers are certified in the care, calibration, and use of the VRAP equipment.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. VRAP aims to visit volunteers during scheduled sampling events to verify that volunteers successfully follow the VRAP protocols. If necessary, volunteers are re-trained during the visit, and the group's monitoring coordinator is notified of the result of the verification visit. Volunteer organizations forward water quality results to the VRAP Coordinator for incorporation into an annual report and state water quality assessment activities.

## 2.4. Data Usage

### 2.4.1. Public Outreach/Water Quality Reports

All data collected by volunteers are summarized in water quality reports that are prepared and distributed after the conclusion of the sampling period (typically fall or winter). Each individual volunteer group receives copies of the report. The volunteers can use the reports and data as a means of understanding the details of water quality, guiding future sampling efforts, or determining restoration activities.

### 2.4.2. State Surface Water Quality Assessments

Along with data collected from other water quality programs, specifically the State Ambient River Monitoring Program, applicable volunteer data are used to support periodic DES surface water quality assessments. VRAP data is entered into NHDES's water quality database and is ultimately uploaded to the Environmental Protection Agency's database; STORET. Assessment results and the methodology used to assess surface waters are published by DES every two years (i.e., Section 305(b) Water Quality Reports) as required by the federal Clean Water Act. The reader is encouraged to log on to the DES web page to review the assessment methodology and list of impaired waters http://www.des.state.nh.us/wmb/swqa/.

## 2.5. Quality Assurance/Quality Control

In order for VRAP data to be used in the assessment of New Hampshire's surface waters, the data must meet quality control guidelines as outlined in the VRAP Quality Assurance Project Plan (QAPP). The VRAP QAPP was approved by NHDES and reviewed by EPA in the summer of 2003. The VRAP Quality Assurance/Quality Control (QA/QC) measures include a six-step approach to ensuring the accuracy of the equipment and consistency in sampling efforts.

- **Calibration**: All meters are calibrated before the first measurement and after the last one. Prior to each measurement, the pH and dissolved oxygen meters are calibrated.
- **Duplicate Analysis**: A second sample is collected at the same time and station as the original sample. The duplicate analysis should not be conducted at the same station over and over again, but should be conducted at different stations throughout the monitoring season. At least 10% of all samples and measurements are duplicates.
- **Replicate Analysis**: A second measurement by each meter is taken from the original sample at one of the stations during the sampling day. As with the duplicate analysis, the replicate analysis should not be conducted at the same station over and over again, but should be conducted at different stations throughout the monitoring season.
- **6.0 pH Standard**: A reading of the pH 6.0 buffer is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the 6.0 pH standard check should be conducted at different stations.
- **DI Turbidity Blank**: A reading of the DI blank is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the blank check should be conducted at different stations.
- **Post-Calibration**: At the conclusion of each sampling day, all meters are calibrated.

## 2.5.1. Measurement Performance Criteria

Precision is calculated for field and laboratory measurements through sample duplicates (environmental variability) and measurement replicates (instrumental variability), and is calculated for each sampling day. The use of VRAP data for assessment purposes is contingent on compliance with a parameter-specific relative percent difference (RPD) as derived from equation 1, below. Any data exceeding the limits of the individual measures are disqualified from surface water quality assessments. All data that exceeds the limits defined by the VRAP QAPP are acknowledged in the data tables with an explanation of why the data was unusable. Table 2-1 shows typical parameters studied under VRAP and the associated quality control procedures.

(Equation 1)

$$RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100 \ \%$$

where $x_1$ is the original sample and $x_2$ is the duplicate/replicate sample

**Table 2- 1. Field Analytical Quality Controls**

| Water Quality Parameter | QC Check | QC Acceptance Limit | Corrective Action | Person Responsible for Corrective Action | Data Quality Indicator |
|---|---|---|---|---|---|
| Temperature | Field duplicate; Measurement replicate | ± 0.2 °C | Repeat measurement | Volunteer Monitors or Program Manager | Precision |
| Dissolved Oxygen | Field duplicate; Measurement replicate | ± 2% of saturation, or ± 0.2 mg/l | Recalibrate instrument, repeat measurement | Volunteer Monitors or Program Manager | Precision |
| | Instrument blank | ± 2% of saturation, or ± 0.2 mg/l | Recalibrate instrument, repeat measurement | Volunteer Monitors or Program Manager | Relative accuracy |
| pH | Field duplicate; measurement replicate | ± 0.1 std units | Recalibrate instrument, repeat measurement | Volunteer Monitors or Program Manager | Precision |
| | Known buffer (pH = 6.0) | ± 0.1 standard units | Recalibrate instrument repeat measurement | Volunteer Monitors or Program Manager | Accuracy |
| Specific Conductance | Field duplicate; measurement replicate | ± 30 µS/cm | Recalibrate instrument, repeat measurement | Volunteer Monitors or Program Manager | Precision |
| | Method blank | ± 5.0 µS/cm | Recalibrate instrument, repeat measurement | Volunteer Monitors or Program Manager | Accuracy |
| Turbidity | Field duplicate; measurement replicate | ± 0.1 NTU | Recalibrate instrument, repeat measurement | Volunteer Monitors or Program Manager | Precision |
| | Method blank | ± 0.1 NTU | Recalibrate instrument, repeat measurement | Volunteer Monitors or Program Manager | Accuracy |

# 3. WATER QUALITY PARAMETERS TYPICALLY MEASURED BY VRAP VOLUNTEERS

## 3.1. Temperature

Temperature is one of the most important and commonly observed water quality parameters. Temperature influences the rate of many physical, chemical and biological processes in the aquatic environment. Each aquatic species has a range of temperature and other factors that best support its reproduction and the survival of offspring. Temperature can also impact aquatic life because of its influence on parameters such as ammonia as well as the concentration of dissolved oxygen in the water.

Temperature in Class B waters shall be in accordance with RSA 485-A:8, II which states in part "any stream temperature increase associated with the discharge of treated sewage, waste or cooling water, water diversions, or releases shall not be such as to appreciably interfere with the uses assigned to this class."

## 3.2. Dissolved Oxygen

Adequate oxygen dissolved in the water is crucial to the survival and successful reproduction of many aquatic species. Organisms such as fish use gills to transfer oxygen to their blood for vital processes that keep the fish active and healthy. Oxygen is dissolved into the water from the atmosphere, aided by wind and wave action where it tumbles over rocks and uneven stream beds. Aquatic plants and algae produce oxygen in the water, but this contribution is offset by respiration at night as well as by bacteria which utilize oxygen to decompose plants and other organic matter into smaller and smaller particles.

Oxygen concentrations in water are measured using a meter that produces readings for both milligrams per liter (mg/L) and percent (%) saturation of dissolved oxygen. For Class B waters, any single dissolved oxygen reading must be greater than 5 mg/L for the water to meet New Hampshire water quality standards. This means that in every liter of water there must be at least five milligrams of dissolved oxygen available for ecosystem processes.

More than one measurement of oxygen saturation taken in a twenty-four hour period can be averaged to compare to the standards. Class B waters must have a dissolved oxygen content of not less than 75% of saturation, based on a daily average. The concentration of dissolved oxygen is dependent on many factors including temperature and sunlight, and tends to fluctuate throughout the day. Saturation values are averaged because a reading taken in the morning may be low due to respiration, while a measurement that afternoon may show that the percent saturation has recovered to acceptable levels. Water can become saturated with more than 100% dissolved oxygen. It should be noted that other dissolved oxygen requirements in the New Hampshire Surface Water Quality Regulations (Env-Ws 1700) pertain to cold water fish spawning areas, impoundments (dams), and reservoirs.

## 3.3. pH

pH is a measure of hydrogen ion activity in water. The lower the pH, the more acidic the solution due to higher concentrations of hydrogen ions. A high pH is indicative of an alkaline or basic environment. pH is measured on a logarithmic scale of 0 to 14. NH rivers typically fall within the range of pH values from 6 to 8. Most aquatic species need a pH of between 5 and 9. pH also affects the toxicity of other aquatic compounds such as ammonia and certain metals.

New Hampshire Surface Water Quality Regulations (Env-Ws 1700) state that pH shall be between 6.5 and 8, unless naturally occurring. Readings that fall outside this range may be due to natural conditions such as the influence of wetlands near the sample station or because of the soils and bedrock in the area. Tannic and humic acids released to the water by decaying plants, for example, can create more acidic waters in areas influenced by wetlands. Low pH can also be due to atmospheric deposition of chemicals emitted by sources such as fossil fuel power plants and car emissions. When it rains, the chemicals in the atmosphere can lower the pH of the rain (commonly referred to as "acid rain"), which can, in turn, lower the pH of the river or stream. Acid rain typically has a pH of 3.5 to 5.5.

## 3.4. Specific Conductance

Specific conductance (informally termed conductivity) is the numerical expression of the ability of water to carry an electric current, and is a measure of the free ion content in the water. Water contains ions (charged particles) which can come from natural sources such as bedrock, or be introduced by human activity. The free ions carry an electrical current. Conductivity can be used to indicate the presence of chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, iron, and aluminum ions.

There is no numeric standard for conductivity because levels naturally vary a great deal according to the geology of an area. Conductivity readings are useful for screening an area to determine potential pollution sources.

## 3.5. Turbidity

Turbidity is an indicator of the amount of suspended material in the water, such as clay, silt, algae, suspended sediment, and decaying plant material. A high degree of turbidity can scatter the passage of light through the water, and inhibit light from reaching important areas. Clean waters are generally associated with low turbidity, but there is a high degree of natural variability involved. Rain events often contribute turbidity to surface waters by flushing sediment, organic matter and other materials from the surrounding landscape into surface waters. According to New Hampshire's Surface Water Quality Regulations (Env-Ws 1700), Class B waters shall not exceed naturally occurring conditions by more than 10 Nephelometric Turbidity Units (NTU).

## 3.6. Bacteria

Organisms causing infections or disease (pathogens) are often excreted in the fecal material of humans and other warm-blooded animals. *Escherichia coli* (*E. coli*) bacteria is not considered pathogenic. *E. coli* is, however, almost universally found in the intestinal tracts of humans and warm blooded animals and is relatively easy and inexpensive to measure. For these reasons *E. coli* is used as an indicator of fecal pollution and the possible presence of pathogenic organisms.

In fresh water, *E. coli* concentrations help determine if the water is safe for recreational uses such as swimming. According to New Hampshire's surface water quality standards, Class B waters shall contain not more than either a geometric mean based on at least three samples obtained over a sixty-day period of 126 *E. coli* per one hundred milliliters (CTS/100mL), or greater than 406 *E. coli* CTS/100mL in any one sample.

## 3.7. Total Phosphorus

Phosphorus is a nutrient that is essential to plants and animals, however, in excess amounts it can cause rapid increases in the biological activity in water. This may disrupt the ecological integrity of streams and rivers.

Phosphate is the form of phosphorus that is readily available for use by aquatic plants. Phosphate is usually the limiting nutrient in freshwater streams, which means relatively small amounts of phosphate can have a large impact on the biological activity in the water. Excess phosphorus can trigger nuisance algal blooms and aquatic plant growth, which can decrease oxygen levels and the attractiveness of waters for recreational purposes.

Phosphorus can be an indicator of sewage, animal manure, fertilizer, erosion, and other types of contamination. There is no surface water quality standard for phosphorus due to the high degree of natural variability and the difficulty of pinpointing the exact source. However 0.05 mg/L total phosphorus is typically used as a level of concern, which means DES pays particular attention to readings above this level.

## 3.8. Metals

Depending on the metal concentration, its form (dissolved or particulate) and the hardness of the water, trace metals can be toxic to aquatic life. Metals in dissolved form are generally more toxic than metals in the particulate form. The dissolved metal concentration is dependent on the pH of the water, as well as the presence of solids and organic matter that can bind with the metal to render it less toxic. Hardness is primarily a measure of the calcium and magnesium ion concentrations in water, expressed as calcium carbonate. The hardness concentration affects the toxicity of certain metals. Numeric criteria for metals may be found in New Hampshire's Surface Water Quality Regulations (Env-Ws 1700).

# 4. MONITORING PROGRAM DESCRIPTION

During the summer of 2001, volunteers from the Ashuelot River Local Advisory Committee began water quality monitoring on the river in conjunction with NHDES's Volunteer River Assessment Program. This effort provides water quality data from the Ashuelot River relative to surface water quality standards. In addition, the ongoing effort allows for an understanding of the river's dynamics, or variations on a station-by-station and year-to-year basis. The data can also serve as a baseline from which to determine any water pollution problems in the river and/or watershed. The Volunteer River Assessment Program has provided field training, equipment, and technical assistance.

Ten stations along the mainstem of the Ashuelot River were monitored in 2003 from its upper limits in Washington to just upstream of its confluence with the Connecticut River in Hinsdale. Sampling station descriptions are provided in Table 4-1 and locations are shown on the foldout map on the following page.

**Table 4-1. Sampling stations for the Ashuelot River, NHDES VRAP, 2003**

| Station ID | Location | Town | Elevation* |
|---|---|---|---|
| 28-ASH | Route 31 | Washington | 1600 |
| 27-ASH | Mountain Road | Lempster | 1500 |
| 24A-ASH | Route 10 | Marlow | 1100 |
| 23-ASH | Route 10 | Gilsum | 800 |
| 20-ASH | Stone Arch Bridge | Keene | 500 |
| 18-ASH | Route 101 | Keene | 500 |
| 16-ASH | Cresson Bridge | Swanzey | 500 |
| 15-ASH | Thompson Bridge | West Swanzey | 400 |
| 07-ASH | Route 119 | Winchester | 400 |
| 01-ASH | 147 River Street | Hinsdale | 200 |

*Elevations have been rounded off to 100-foot increments for purposes of calibrating the dissolved oxygen meter.

# 5. RESULTS AND DISCUSSION

## 5.1. Dissolved Oxygen

### 5.1.1. Results and Discussion

Five measurements were taken in the field for dissolved oxygen concentration at ten stations on the mainstem of the Ashuelot River from Washington to Hinsdale (Table 5-1). Of the 50 measurements taken, 40 met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency.

The Class B New Hampshire surface water quality standard for dissolved oxygen includes a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be assessed as meeting dissolved oxygen standards.

**Table 5-1. Dissolved Oxygen Data Summary for the Ashuelot River 2003, VRAP**

| Station ID | Samples Collected | Data Range (mg/L) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2004 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 5 | 7.22 - 9.70 | 0 | 4[a] |
| 27-ASH | 5 | 7.35 - 11.6 | 0 | 4[a] |
| 24A-ASH | 5 | 7.25 - 9.66 | 0 | 4[a] |
| 23-ASH | 5 | 7.99 – 13.00 | 0 | 4[a] |
| 20-ASH | 5 | 6.33 - 9.58 | 0 | 4[a] |
| 18-ASH | 5 | 6.22 - 9.70 | 0 | 4[a] |
| 16-ASH | 5 | 6.70 - 9.75 | 0 | 4[a] |
| 15-ASH | 5 | 6.43 - 9.57 | 0 | 4[a] |
| 07-ASH | 5 | 7.30 - 9.37 | 0 | 4[a] |
| 01-ASH | 5 | 7.88 - 10.74 | 0 | 4[a] |
| **Total Number of Useable Samples for 2004 NH Surface Water Quality Assessment** | | | | **40** |

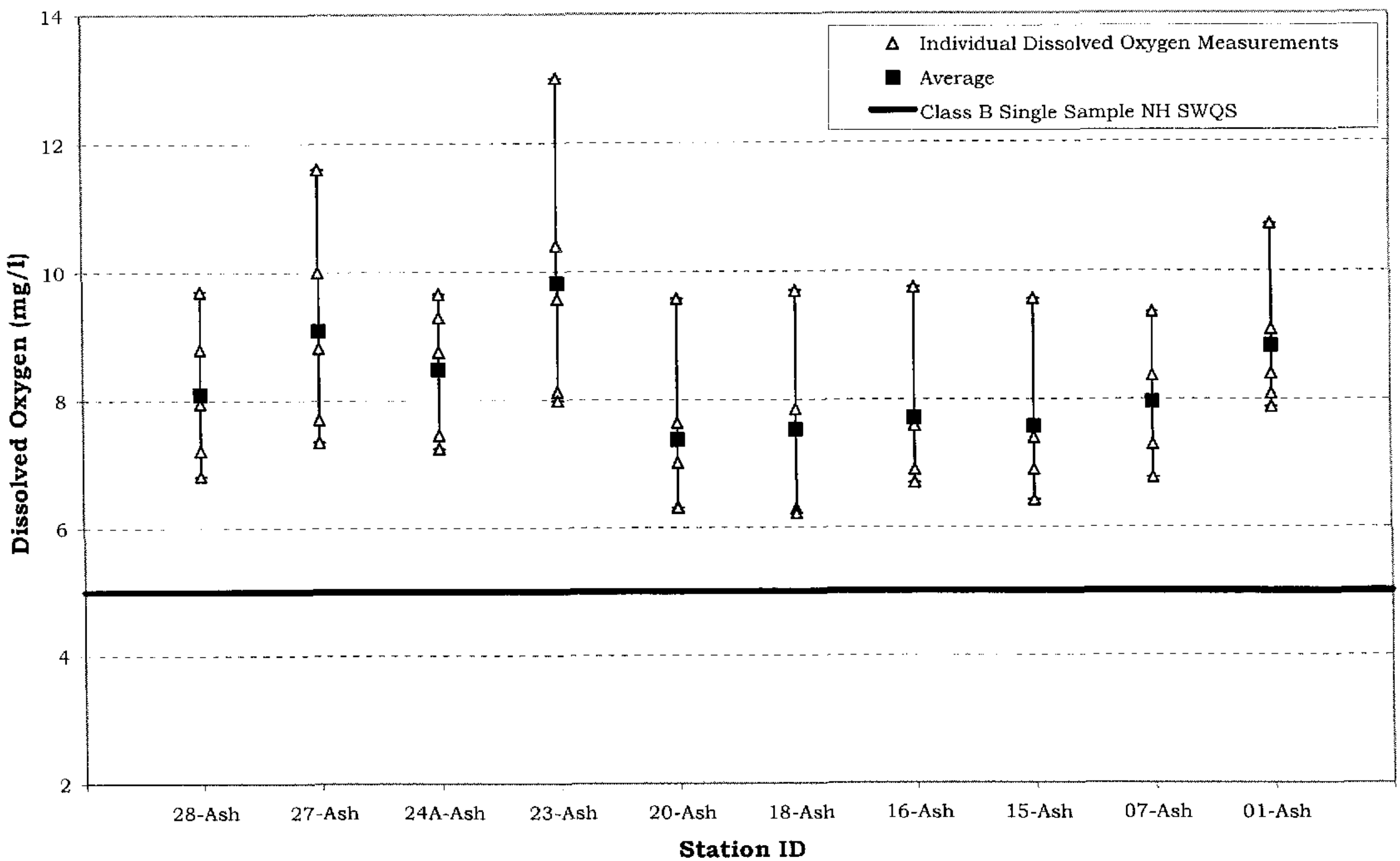
[a]Relative % differences of both Rep and Dup exceeded standard in QAPP on 7/26/03

Dissolved oxygen concentration levels were above state standards on all occasions and at all stations [Figure 5-1]. The average concentration of dissolved oxygen was consistently above the Class B standard at all stations ranging from 7.4 mg/L to 9.8 mg/L. Levels of dissolved oxygen sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions.

### 5.1.2. Recommendations

- Continue sampling at all stations to develop a long-term data set to better understand trends as time goes on.
- If possible, take measurements between 5:00 a.m. and 10:00 a.m., which is when dissolved oxygen is usually the lowest, and between 2:00 noon and 7:00 p.m. when dissolved oxygen is usually the highest.
- Next year incorporate the use of submersible meters to automatically record dissolved oxygen saturation levels during a period of several days. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 15 minutes). The instrument can be put in the stream and left alone for a period of several days. The use of these instruments is dependent upon availability, and requires coordination with DES.

**Figure 5-1. Dissolved Oxygen Statistics for the Ashuelot River, New Hampshire, June 26 - September 3, 2003, NHDES VRAP**



## 5.2. pH

### 5.2.1. Results and Discussion

Five measurements were taken in the field for pH at ten stations on the mainstem of the Ashuelot River from Washington to Hinsdale (Table 5-2). Of the 50 measurements taken, 40 met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. The Class B New Hampshire surface water quality standard is 6.5-8.0, unless naturally occurring.

**Table 5-2. pH Data Summary for the Ashuelot River 2003, VRAP**

| Station ID | Samples Collected | Data Range (standard units) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2004 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 5 | 5.48 - 6.00 | 5 | 4[a] |
| 27-ASH | 5 | 5.47 - 5.89 | 5 | 4[a] |
| 24A-ASH | 5 | 5.53 - 6.16 | 5 | 4[a] |
| 23-ASH | 5 | 5.81 - 6.61 | 3 | 4[a] |
| 20-ASH | 5 | 5.92 - 6.76 | 3 | 4[a] |
| 18-ASH | 5 | 6.01 - 6.59 | 3 | 4[a] |
| 16-ASH | 5 | 6.09 - 6.69 | 2 | 4[a] |
| 15-ASH | 5 | 5.79 - 6.58 | 2 | 4[a] |
| 07-ASH | 5 | 5.9 - 6.67 | 2 | 4[a] |
| 01-ASH | 5 | 6.26 - 7.36 | 2 | 4[a] |
| **Total Number of Useable Samples for 2004 NH Surface Water Quality Assessment** | | | | **40** |

[a] 7/26/02; Replicate and duplicate > .2 units from sample

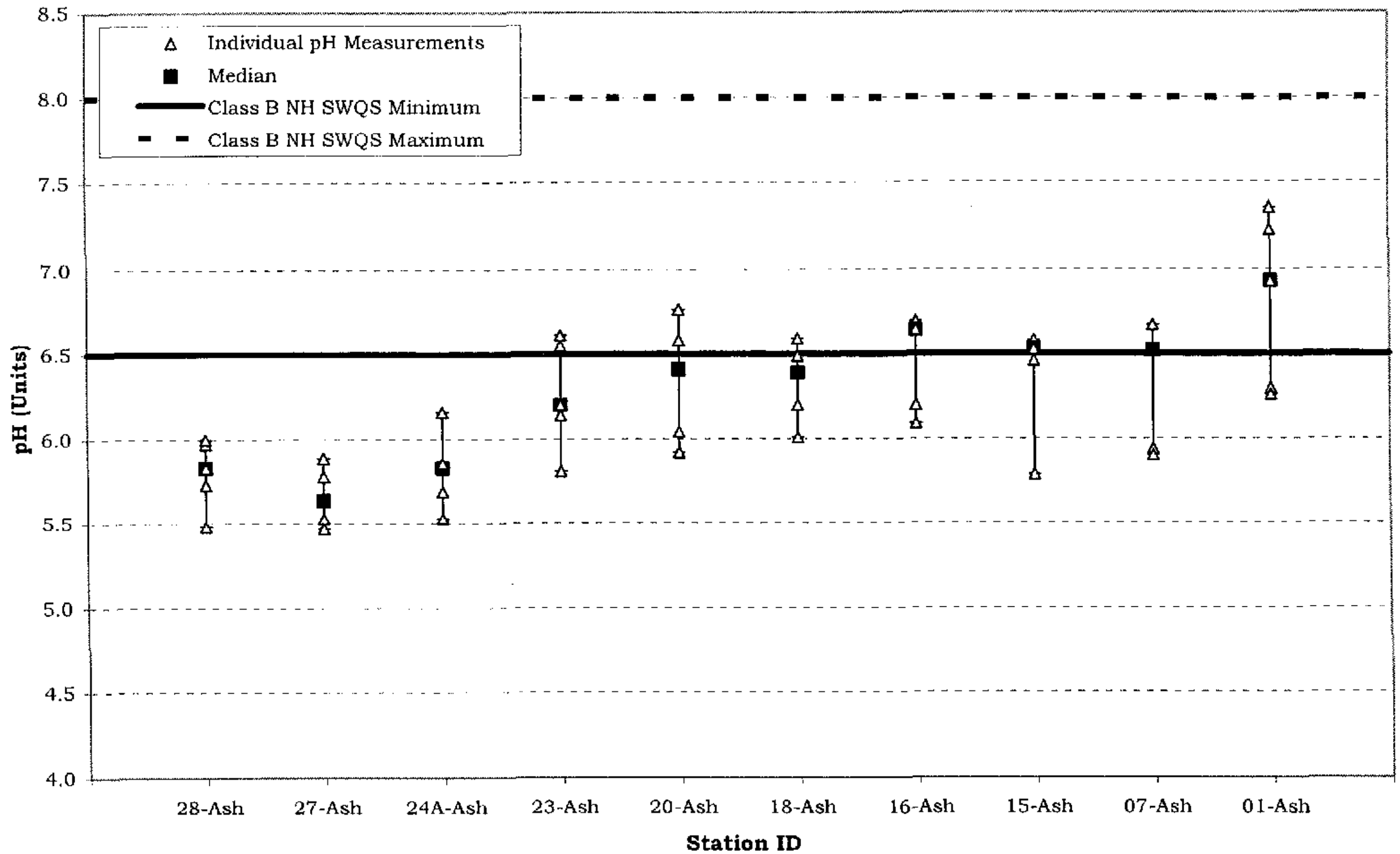
The pH levels in the upper reaches of the river (i.e., Washington to Marlow) were always outside of the range of the New Hampshire surface water quality standard (Figure 5-2). This is likely the result of natural conditions such as the soils, geology, or the presence of wetlands in the area. It should be noted that rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels.

The pH levels in other reaches of the river downstream from Marlow were variable, both within and outside of the range of the New Hampshire surface water quality standard. In general, pH increased downstream from Keene to Hinsdale, although the lowest pH levels in this reach were never within the range of the surface water quality standard. The pattern of increasing pH may be the result of a greater number of cations (positively charge elements such as sodium and calcium), which typically increase in urbanized areas. This can be related to the increased specific conductance levels found in this reach of the river (see Section 5.4).

### 5.2.2. Recommendations

- Continue sampling at all stations; this will help to build a long-term data set to better understand trends as time goes on.
- Consider sampling for pH in some of the tributaries and wetland areas that are influencing the pH of stations with measurements below state standards. Site conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes.* Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.

**Figure 5-2. pH Statistics for the Ashuelot River, New Hampshire, May 17- September 13, 2003, NHDES VRAP**



## 5.3. Turbidity

### 5.3.1. Results and Discussion

Either four or five measurements were taken in the field for turbidity at ten stations on the mainstem of the Ashuelot River from Washington to Hinsdale (Table 5-3). All measurements met QA/QC requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. The Class B New Hampshire surface water quality standard for turbidity is less than 10 NTU above background.

**Table 5-3 Turbidity Data Summary for the Ashuelot River 2003, VRAP**

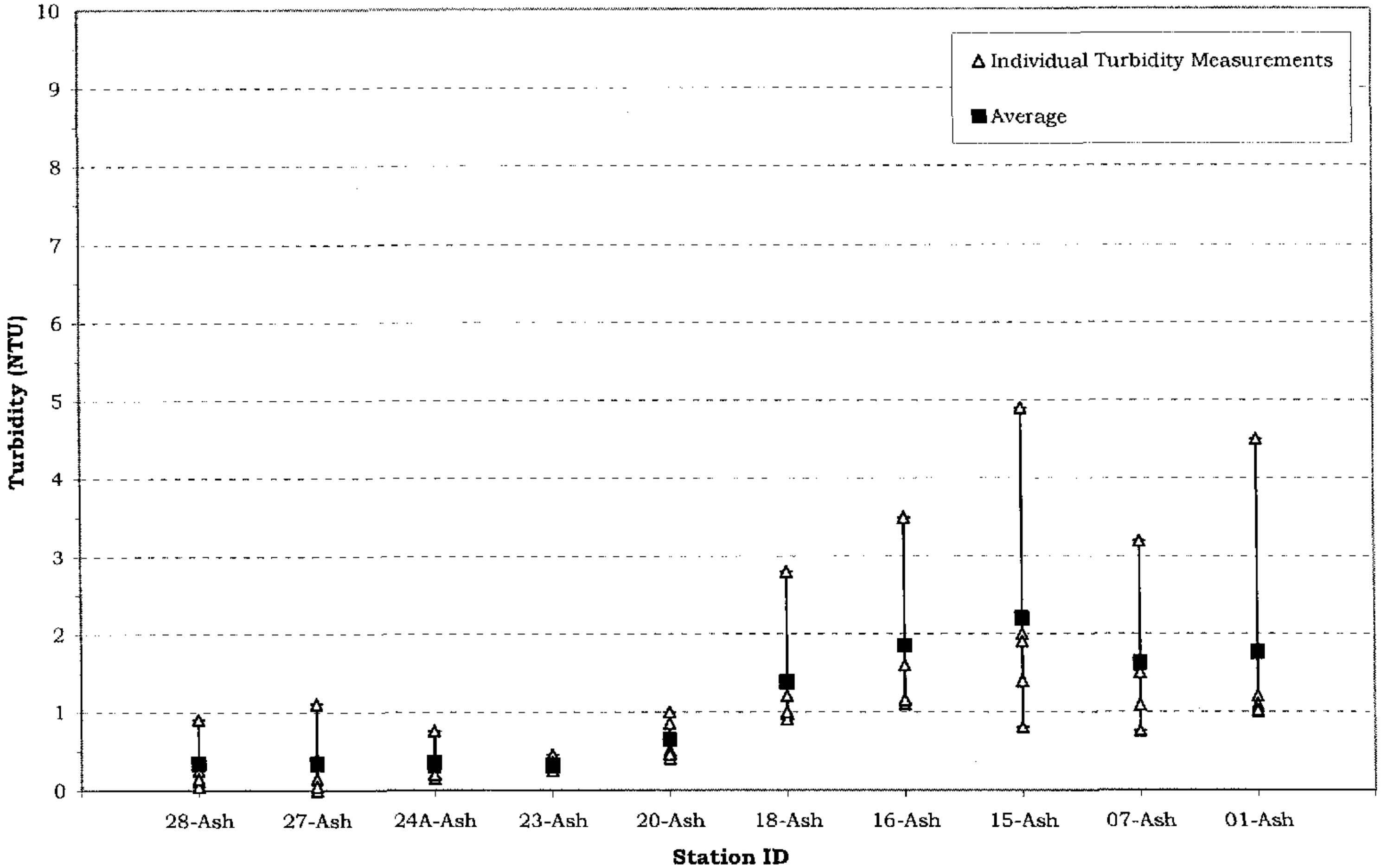
| Station ID | Samples Collected | Data Range (NTU) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2004 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 4 | 0.05 - 0.9 | 0 | 4 |
| 27-ASH | 5 | 0.0 - 1.1 | 0 | 5 |
| 24A-ASH | 5 | 0.2 - 0.75 | 0 | 5 |
| 23-ASH | 5 | 0.25 - 0.45 | 0 | 5 |
| 20-ASH | 5 | 0.4 - 1.0 | 0 | 5 |
| 18-ASH | 5 | 0.9 - 2.8 | 0 | 5 |
| 16-ASH | 5 | 1.1 - 3.5 | 0 | 5 |
| 15-ASH | 5 | 0.8 - 4.9 | 0 | 5 |
| 07-ASH | 5 | 0.75 - 3.2 | 0 | 5 |
| 01-ASH | 5 | 1.0 - 4.5 | 0 | 5 |
| **Total Number of Useable Samples for 2004 NH Surface Water Quality Assessment** | | | | **49** |

Turbidity levels were low on all occasions and at all stations with the average ranging from 0.3 NTU to 1.8 NTU (Figure 5-3). Although clean waters are associated with low turbidity there is a high degree of natural variability involved. Precipitation often contributes to increased turbidity by flushing sediment, organic matter and other materials from the surrounding landscape into surface waters. However, human activities such as removal of vegetation near surface waters and disruption of nearby soils can lead to dramatic increases in turbidity levels. In general it is typical to see a rise in turbidity in more developed areas due to increased runoff. Figure 5-3 shows an increase in turbidity averages as one moves downstream towards the more urban areas near Keene. Turbidity levels during 2003 will be a useful indicator of the typical background conditions of the river.

### 5.3.2. Recommendations

- Continue sampling at all stations as this will help to build a long-term data set to better understand trends as time goes on.
- Collect samples during wet weather; this will help us to understand how the river responds to runoff and sedimentation.
- If a higher than normal turbidity measurement occurs, volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated turbidity levels. In addition, take good field notes and photographs.

**Figure 5-3. Turbidity Statistics for the Ashuelot River, New Hampshire, May 17, - September 13, 2003, NHDES VRAP**



## 5.4. Specific Conductance

### 5.4.1. Results and Discussion

Five measurements were taken in the field for specific conductance at ten stations on the mainstem of the Ashuelot River from Washington to Hinsdale (Table 5-4). All measurements met QA/QC requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. A Class B New Hampshire surface water quality standard does not exist for specific conductance.

**Table 5-4 Specific Conductance Data Summary for the Ashuelot River 2003, VRAP**

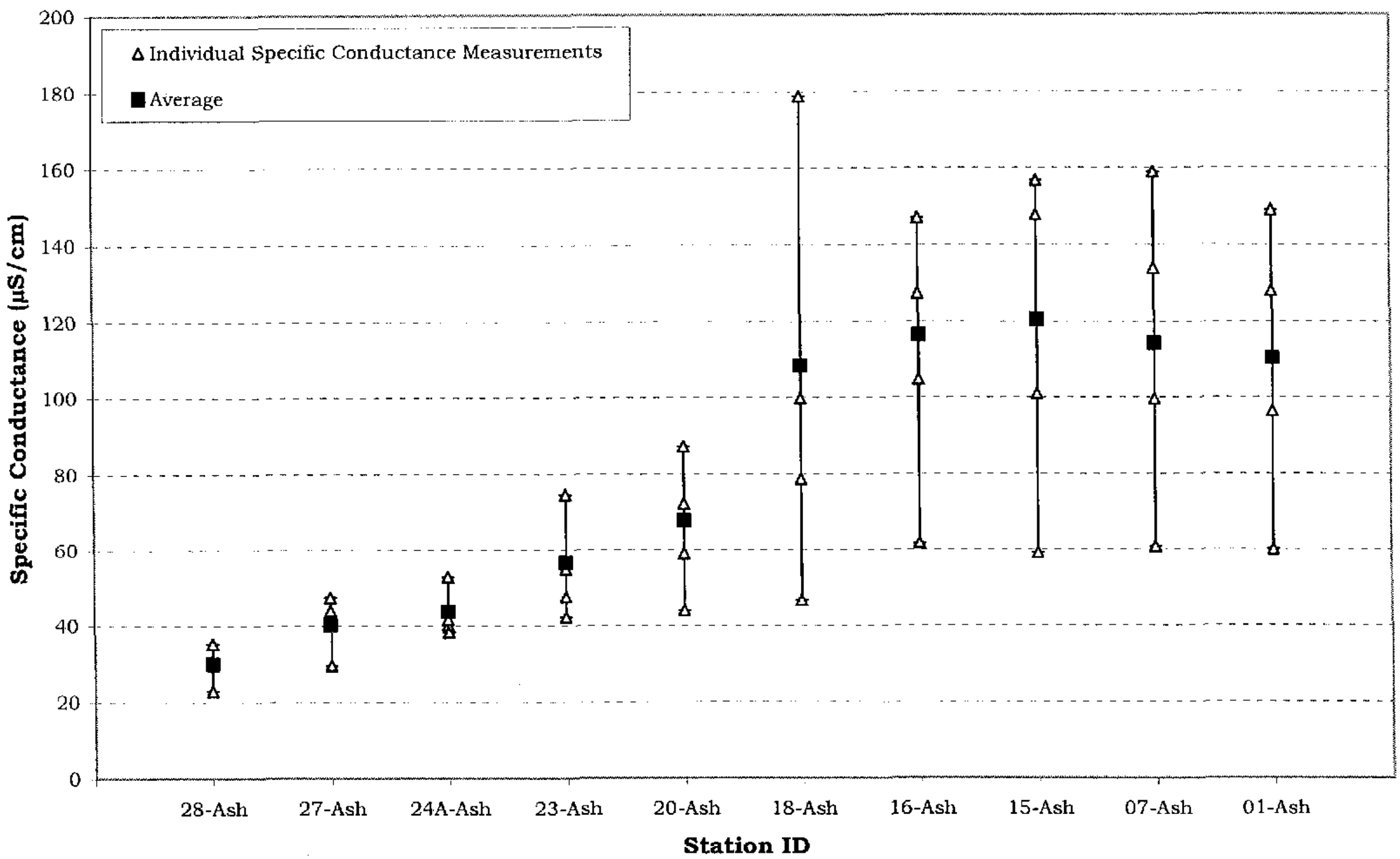
| Station ID | Samples Collected | Data Range (µS/cm) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2004 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| **28-ASH** | 5 | 22.9 - 35.2 | Not Applicable | 5 |
| **27-ASH** | 5 | 29.4 - 43.9 | N/A | 5 |
| **24A-ASH** | 5 | 40.1 - 53.0 | N/A | 5 |
| **23-ASH** | 5 | 42.2 - 74.7 | N/A | 5 |
| **20-ASH** | 5 | 43.9 - 87.2 | N/A | 5 |
| **18-ASH** | 5 | 46.7 - 178.8 | N/A | 5 |
| **16-ASH** | 5 | 61.8 - 146.9 | N/A | 5 |
| **15-ASH** | 5 | 59.3 - 156.7 | N/A | 5 |
| **07-ASH** | 5 | 60.8 - 158.9 | N/A | 5 |
| **01-ASH** | 5 | 60.1 - 148.8 | N/A | 5 |
| **Total Number of Useable Samples for 2004 NH Surface Water Quality Assessment** | | | | **50** |

Specific conductance levels were variable along the entire reach of the river (Figure 5-4). The influence of urbanization on specific conductance is apparent by the increased levels from the more rural upstream areas to the more urbanized areas near Keene. Anions (negatively charged elements such as chloride) and cations (positively charged elements such as calcium) are typically found in rivers flowing through urbanized areas. Specific conductance generally increased in spring and throughout the rest of the summer at all stations, likely because elevated river flows diluted specific conductance levels.

### 5.4.2. Recommendations

- Continue sampling at all stations as this will help to build a long-term data set to better understand trends as time goes on.

**Figure 5-4. Specific Conductance Statistics for the Ashuelot River, New Hampshire, May 17 - September 13, 2003, NHDES VRAP**



## 5.5. Bacteria/*Escherichia coli*

### 5.5.1. Results and Discussion

Either three or four measurements were taken in the field for *Escherichia coli* (*E. coli*) at 10 stations from Washington to Hinsdale (Table 5-5). All measurements met QA/QC requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. Class B NH surface water quality standards for *E.coli* are as follows:

<406 cts/100 ml, based on any single sample, or
<126 cts/100 ml, based on a geometric mean calculated from three samples collected within a 60-day period.

**Table 5-5 *E. coli* Data Summary for the Ashuelot River 2003, VRAP**

| Station ID | Samples Collected | Data Range (cts/100ml) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2004 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| **28-ASH** | 3 | 3 - 6 | 0 | 3 |
| **27-ASH** | 4 | 1 - 42 | 0 | 4 |
| **24A-ASH** | 4 | 6 - 34 | 0 | 4 |
| **23-ASH** | 4 | 10 - 25 | 0 | 4 |
| **20-ASH** | 4 | 11 - 96 | 0 | 4 |
| **18-ASH** | 4 | 48 - 155 | 0 | 4 |
| **16-ASH** | 4 | 77 - 210 | 0 | 4 |
| **15-ASH** | 4 | 65 - 185 | 0 | 4 |
| **07-ASH** | 4 | 24 - 109 | 0 | 4 |
| **01-ASH** | 4 | 66 - 80 | 0 | 4 |
| **Total Number of Useable Samples for 2004 NH Surface Water Quality Assessment** | | | | **39** |

None of the stations tested for *E.coli* had single sample levels which exceeded the New Hampshire surface water quality standard (Figure 5-5). In order for a geometric mean to be computed three samples must be collected within a 60-day period. At all stations three or four measurements were taken over the course of the monitoring season. This allows DES to calculate a rolling geometric mean [Table 5-6]. As the table indicates only one station [16-ASH] violated the standard of <126 cts/100 ml, based on a geometric mean calculated from three samples collected within a 60-day period.

Several factors can contribute to elevated *E. coli* levels, including, but not limited to rain storms, low river flows, the presence of wildlife (e.g., birds), and the presence of septic systems along the river.

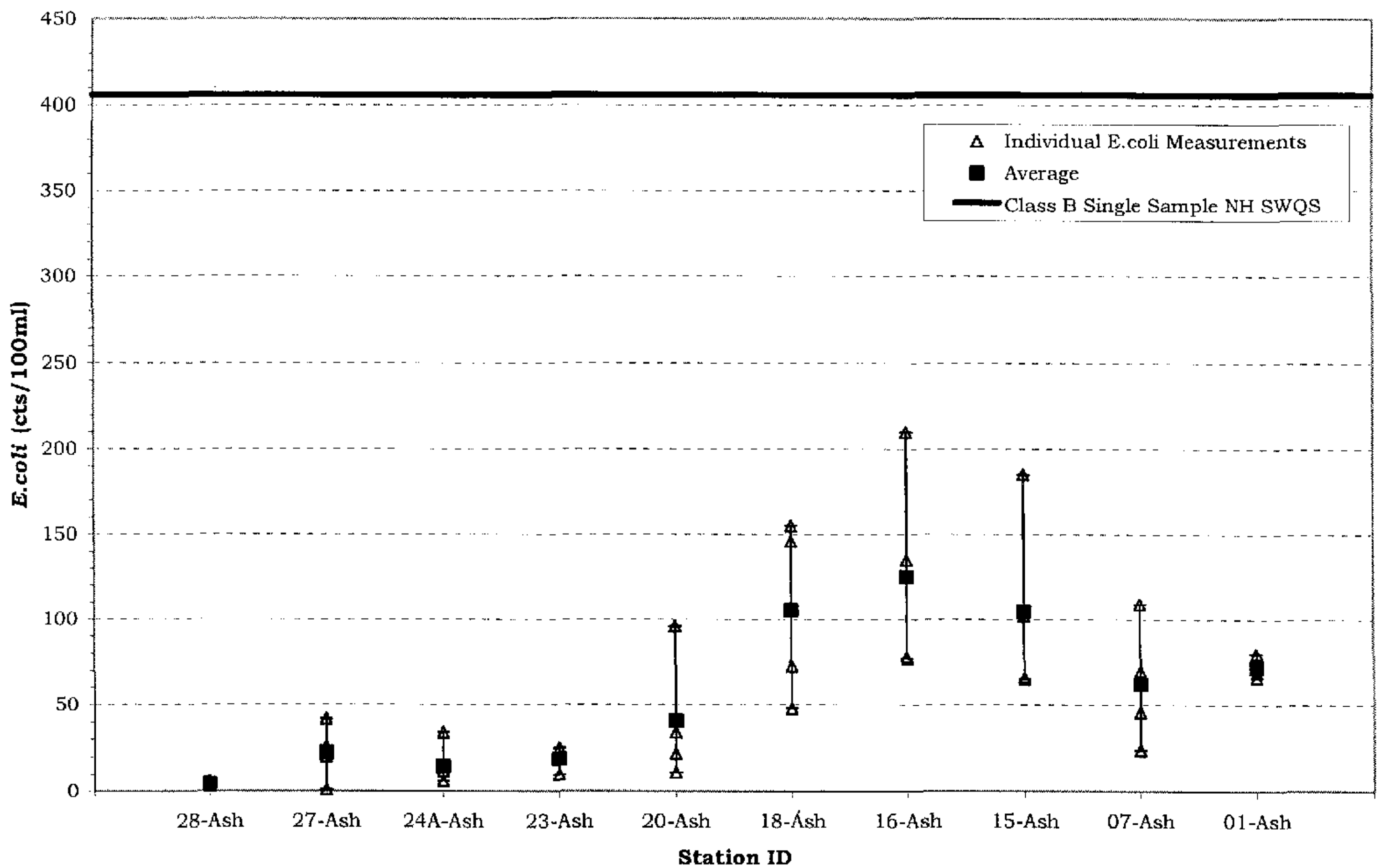
**Table 5-6 Rolling geometric means for *E. coli* data, Ashuelot River 2003, VRAP**

| Station ID | Geometric Mean 6/28/03 - 8/16/03 | Geometric Mean 7/26/03 - 9/13/03 | Geometric Means Not Meeting NH Class B Standards |
|---|---|---|---|
| 28-ASH | NA | 4 | 0 |
| 27-ASH | 28 | 9 | 0 |
| 24A-ASH | 13 | 8 | 0 |
| 23-ASH | 22 | 17 | 0 |
| 20-ASH | 42 | 29 | 0 |
| 18-ASH | 103 | 80 | 0 |
| 16-ASH | 130 | 93 | 1 |
| 15-ASH | 93 | 76 | 0 |
| 07-ASH | 71 | 49 | 0 |
| 01-ASH | 69 | 71 | 0 |

### 5.5.2. Recommendations

- Continue collecting three samples within any 60-day period during the summer to allow for determination of geometric means.
- Continue to document river conditions and station characteristics (including the presence of wildlife in the area during sampling).
- At stations with particularly high bacteria levels (i.e. 16-ASH), if volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated bacteria levels. Those sampling should also look for any potential sources of bacteria such as emission pipes and failed septic systems.

**Figure 5-5. *E. coli* Statistics for the Ashuelot River, New Hampshire, May 17 - September 13, 2003, NHDES VRAP**



## 5.6. Total Phosphorus

### 5.6.1. Results and Discussion

Either four or five samples were collected for total phosphorous at 10 stations from Washington to Hinsdale (Table 5-7). All sample results met QA/QC requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. A numeric Class B NH surface water quality standard does not exist for total phosphorus. However, a total phosphorus concentration of 0.05 mg/L is used by NHDES as a level of concern and the agency pays particular attention to results above this level.

**Table 5-7 Total Phosphorous Data Summary for the Ashuelot River 2003, VRAP**

| Station ID | Samples Collected | Data Range (mg/L) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2004 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 4 | 0.005 - 0.01 | Not Applicable | 4 |
| 27-ASH | 4 | 0.008 - 0.02 | N/A | 4 |
| 24A-ASH | 5 | 0.005 - 0.011 | N/A | 5 |
| 23-ASH | 5 | 0.005 - 0.014 | N/A | 5 |
| 20-ASH | 5 | 0.005 - 0.02 | N/A | 5 |
| 18-ASH | 5 | 0.008 - 0.02 | N/A | 5 |
| 16-ASH | 5 | 0.028 - 0.097 | N/A | 5 |
| 15-ASH | 5 | 0.035 - 0.13 | N/A | 5 |
| 07-ASH | 5 | 0.041 - 0.082 | N/A | 5 |
| 01-ASH | 5 | 0.023 - 0.068 | N/A | 5 |
| **Total Number of Useable Samples for 2004 NH Surface Water Quality Assessment** | | | | **48** |

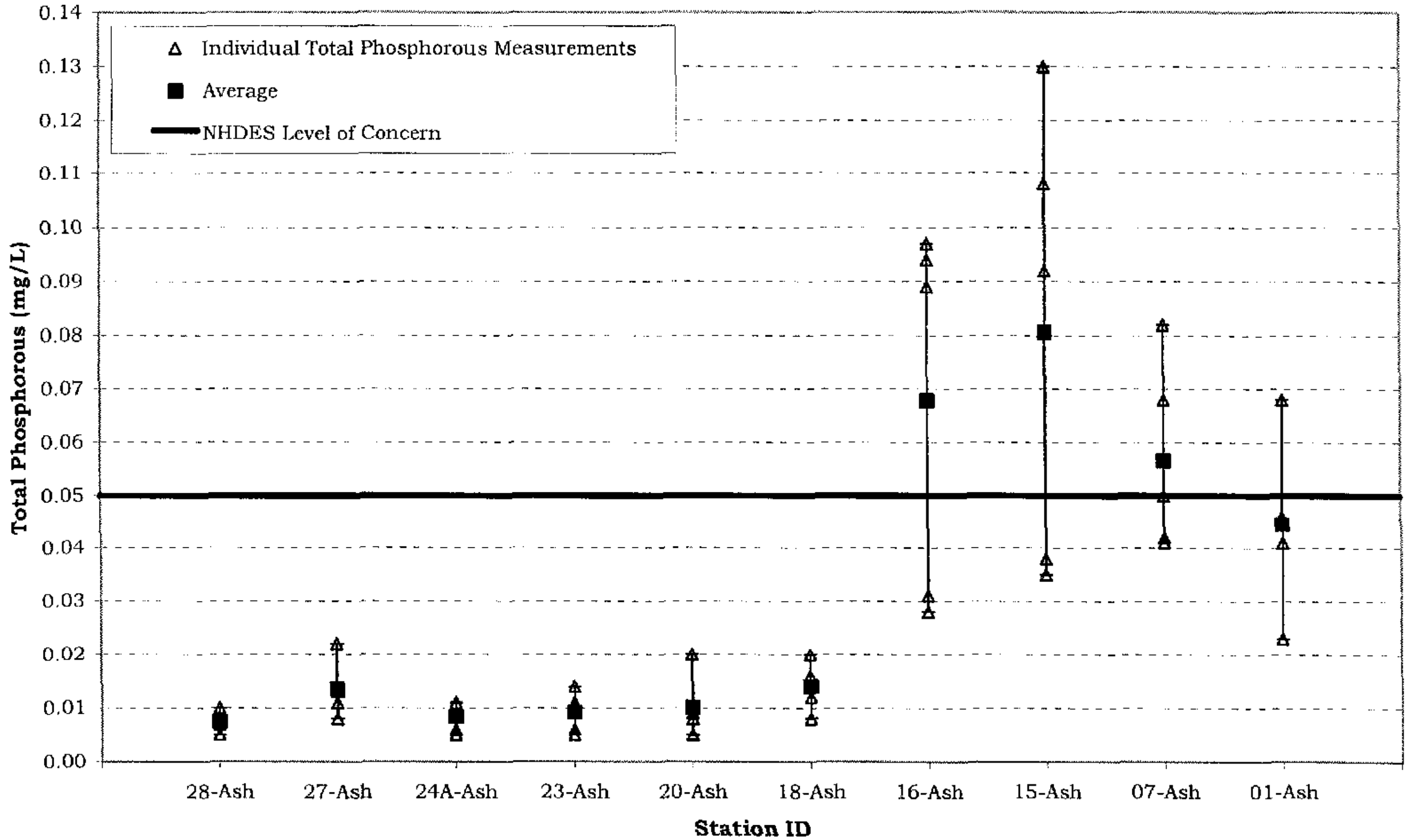
On at least one occasion, the four most downstream stations did have total phosphorous levels that exceeded NHDES's level of concern [Figure 5-6]. Under undisturbed natural condition phosphorous is at very low levels in aquatic ecosystems. Of the three nutrients critical for aquatic plant growth; potassium, nitrogen, and phosphorous, it is usually phosphorous that is the limiting factor to plant growth. When the supply of phosphorous is increased due to human activity algae respond with significant growth.

A major source of excessive phosphorous concentrations in aquatic ecosystems can be wastewater treatment facilities, as sewage typically contains relatively high levels of phosphorus detergents. However, fertilizers used on lawns and agricultural areas can also contribute significant amounts of phosphorus

### 5.6.2. Recommendations

- At stations with elevated total phosphorous levels, begin sampling for Chlorophyll-a. As mentioned above, high concentrations of phosphorous will lead to an increase in algal growth. Because algae is a plant and contains Chlorophyll-a the concentration of Chlorophyll-a found in the water will give an estimation of the concentration of algae. NHDES uses Chlorophyll-a as an indicator of total phosphorus levels and in the assessment of surface water for primary contact recreation.

**Figure 5-6. Total Phosphorous Statistics for the Ashuelot River, New Hampshire, May 17 - September 13, 2003, NHDES VRAP**



# APPENDIX
# 2003 ASHUELOT RIVER WATER QUALITY DATA

# 2003 ASHUELOT RIVER VRAP DATA

| | |
|---|---|
| | Measurements not meeting New Hampshire surface water quality standards |
| | Total Phosphorous measurements exceeding NHDES level of concern |
| | Measurements not meeting NHDES quality assurance/quality control standards |

*Abbreviated standards for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

**2003 VRAP Ashuelot River Baseline Parameters**
**28-Ash, Route 31, Washington, NH**

| Date | Time of Sample | Weather | DO (mg/L) | DO (% sat.) | H2O Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) |
|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75% Daily Average | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd | NA |
| 5/17/03 | 8:12 | O | 9.7 | 89 | 11.5 | 6.5 | 5.73 | 0.05 | 29.6 |
| 6/28/03 | 8:00 | PC | 6.82 | 80.8 | 23.7 | 18.5 | 5.97 | | 32 |
| 7/26/03 | 8:04 | C | 8.8 | 96.8 | 19.6 | 18.7 | 5.48 | 0.25 | 35.2 |
| 8/16/03 | 8:25 | C | 7.22 | 85.3 | 23.9 | 22.3 | 5.83 | 0.9 | 22.9 |
| 9/13/03 | 8:00 | O | 7.95 | 82.8 | 17.1 | 15.6 | 6 | 0.15 | 30.1 |

**2003 VRAP Ashuelot River Additional Parameters**
**28-Ash, Route 31, Washington, NH**

| Date | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|
| Standard* | NA | <406 | <126 | NA |
| 5/17/03 | 8:12 | | | 0.008 |
| 7/26/03 | 8:04 | 3 | | 0.007 |
| 8/16/03 | 8:25 | 6 | | 0.01 |
| 9/13/03 | 8:00 | 4 | 4 | 0.005 |

**2003 VRAP Ashuelot River Baseline Parameters**
**27-Ash, Mountain Road, Lempster, NH**

| | Time of | | | | H2O Temp. | Air Temp. | | Turbidity | Specific |
|---|---|---|---|---|---|---|---|---|---|

| Date | Sample | Weather | DO (mg/L) | DO (% sat.) | (°C) | (°C) | pH | (NTUs) | Conductance (uS/cm) |
|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75% Daily Average | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd | NA |
| 5/17/03 | 9:07 | O | 10 | 91.3 | 11.4 | 8 | 5.64 | 0 | 41.5 |
| 6/28/03 | 8:45 | PC | 7.7 | 86.5 | 22.1 | 19.8 | 5.78 | 0.4 | 39.3 |
| 7/26/03 | 8:49 | C | 11.6 | 125 | 19.2 | 19.2 | 5.53 | 0.15 | 47.4 |
| 8/16/03 | 9:15 | C | 7.35 | 85 | 22.5 | 21.9 | 5.47 | 1.1 | 29.4 |
| 9/13/03 | 8:40 | O | 8.82 | 82.7 | 14.8 | 15.4 | 5.89 | 0.05 | 43.9 |

**2003 VRAP Ashuelot River Additional Parameters**

**27-Ash, Mountain Road, Lempster, NH**

| Date | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|
| Standard* | NA | <406 | <126 | NA |
| 6/28/03 | 8:45 | 26 | | 0.013 |
| 7/26/03 | 8:49 | 42 | | 0.022 |
| 8/16/03 | 9:15 | 20 | 28 | 0.011 |
| 9/13/03 | 8:40 | 1 | 9 | 0.008 |

**2003 VRAP Ashuelot River Baseline Parameters**

**24A-Ash, Route 10, Marlow, NH**

| Date | Time of Sample | Weather | DO (mg/L) | DO (% sat.) | H2O Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) |
|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75% Daily Average | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd | NA |
| 5/17/03 | 10:14 | O | 9.66 | 93.1 | 15.7 | 13 | 5.83 | 0.3 | 40.1 |
| 6/28/03 | 9:30 | PC | 7.45 | 89.8 | 25.1 | 21 | 6.16 | 0.35 | 45.7 |
| 7/26/03 | 9:31 | C | 9.3 | 110.5 | 23.5 | 22.9 | 5.69 | 0.15 | 53 |
| 8/16/03 | 9:54 | C | 7.25 | 85.8 | 23.8 | 23.3 | 5.53 | 0.75 | 41.6 |
| 9/13/03 | 9:12 | O | 8.76 | 92.6 | 18.1 | 16.3 | 5.86 | 0.2 | 38.2 |

**2003 VRAP Ashuelot River Additional Parameters**

24A-Ash, Route 10, Marlow, NH

| Date | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|
| Standard* | NA | <406 | <126 | NA |
| 5/17/03 | 10:14 | | | 0.006 |
| 6/28/03 | 9:30 | 34 | | 0.009 |
| 7/26/03 | 9:31 | 6 | | 0.011 |
| 8/16/03 | 9:54 | 12 | 13 | 0.011 |
| 9/13/03 | 9:12 | 6 | 8 | 0.005 |

**2003 VRAP Ashuelot River Baseline Parameters**
**23-Ash, Route 10, Gilsum, NH**

| Date | Time of Sample | Weather | DO (mg/L) | DO (% sat.) | H2O Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) |
|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75% Daily Average | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd | NA |
| 5/17/03 | 10:47 | O | 10.41 | 98.1 | 12.5 | 14.9 | 6.14 | 0.25 | 47.6 |
| 6/28/03 | 10:30 | PC | 8.13 | 94.5 | 21.9 | 23.5 | 6.55 | 0.25 | 64.1 |
| 7/26/03 | 9:59 | C | 13 | 143 | 20.4 | 21.5 | 6.2 | 0.25 | 74.7 |
| 8/16/03 | 10:22 | C | 7.99 | 93.6 | 22.9 | 24 | 5.81 | 0.45 | 42.2 |
| 9/13/03 | 9:38 | O | 9.58 | 97.2 | 15.7 | 16.6 | 6.61 | 0.35 | 55 |

**2003 VRAP Ashuelot River Additional Parameters**
**23-Ash, Route 10, Gilsum, NH**

| Date | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|
| Standard* | NA | <406 | <126 | NA |
| 5/17/03 | 10:47 | | | 0.006 |
| 6/28/03 | 10:30 | 20 | | 0.011 |
| 7/26/03 | 9:59 | 25 | | 0.01 |
| | | | | |

| | | | | |
|---|---|---|---|---|
| 8/16/03 | 10:22 | 20 | 22 | 0.014 |
| 9/13/03 | 9:38 | 10 | 17 | 0.005 |

**2003 VRAP Ashuelot River Baseline Parameters**
**20-Ash, Stone Arch Bridge, Keene, NH**

| Date | Time of Sample | Weather | DO (mg/L) | DO (% sat.) | H2O Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) |
|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75% Daily Average | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd | NA |
| 5/17/03 | 9:10 | C | 9.58 | 90.6 | 12.9 | 9.9 | 6.41 | 0.85 | 59.1 |
| 6/28/03 | 8:30 | C | 6.33 | 76.3 | 23.5 | 22.1 | 6.58 | 0.5 | 77.2 |
| 7/26/03 | 8:00 | PC | 6.31 | 73.5 | 21.7 | 18.8 | 6.76 | 0.4 | 87.2 |
| 8/16/03 | 8:30 | O | 7.02 | 81.5 | 22.5 | 21.4 | 6.04 | 1 | 43.9 |
| 9/13/03 | 8:10 | O | 7.64 | 77.9 | 17.2 | 15.4 | 5.92 | 0.45 | 72.3 |

**2003 VRAP Ashuelot River Additional Parameters**
**20-Ash, Stone Arch Bridge, Keene, NH**

| Date | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|
| Standard* | NA | <406 | <126 | NA |
| 5/17/03 | 9:10 | | | 0.008 |
| 6/28/03 | 8:30 | 34 | | 0.009 |
| 7/26/03 | 8:00 | 96 | | 0.008 |
| 8/16/03 | 8:30 | 22 | 42 | 0.02 |
| 9/13/03 | 8:10 | 11 | 29 | 0.005 |

**2003 VRAP Ashuelot River Baseline Parameters**
**18-Ash, Route 101, Keene, NH**

| Date | Time of Sample | Weather | DO (mg/L) | DO (% sat.) | H2O Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | >75% Daily | | | | <10 NTU | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | Average | Narrative | NA | 6.5-8.0 | above backgrd | NA |
| 5/17/03 | 9:52 | C | 9.7 | | 12.4 | 11.6 | 6.39 | 1 | 78.7 |
| 6/28/03 | 9:30 | C | 6.3 | 77.6 | 23.9 | 23.7 | 6.49 | 1.2 | 137.8 |
| 7/26/03 | 9:20 | PC | 6.22 | 71.7 | 22.4 | 22.1 | 6.59 | 0.9 | 178.8 |
| 8/16/03 | 9:15 | O | 7.85 | 90.3 | 22.7 | 23.5 | 6.01 | 2.8 | 46.7 |
| 9/13/03 | 9:00 | O | 7.59 | 81.5 | 17.4 | 16.7 | 6.2 | 1 | 99.8 |

**2003 VRAP Ashuelot River Additional Parameters**
**18-Ash, Route 101, Keene, NH**

| Date | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|
| Standard* | NA | <406 | <126 | NA |
| 5/17/03 | 9:52 | | | 0.012 |
| 6/28/03 | 9:30 | 155 | | 0.014 |
| 7/26/03 | 9:20 | 146 | | 0.016 |
| 8/16/03 | 9:15 | 48 | 103 | 0.02 |
| 9/13/03 | 9:00 | 73 | 80 | 0.008 |

**2003 VRAP Ashuelot River Baseline Parameters**
**16-Ash, Cresson Bridge, Swanzey, NH**

| Date | Time of Sample | Weather | DO (mg/L) | DO (% sat.) | H2O Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) |
|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75% Daily Average | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd | NA |
| 5/17/03 | 10:51 | C | 9.75 | 90.8 | 12.3 | 11 | 6.69 | 1.1 | 104.8 |
| 6/28/03 | 10:30 | C | 6.91 | 81.2 | 22.6 | 22.9 | 6.64 | 1.6 | 141.6 |
| 7/26/03 | 10:00 | PC | 6.7 | 75.5 | 22.1 | 22.5 | 6.64 | 1.15 | 146.9 |
| 8/16/03 | 10:04 | O | 7.6 | 89.5 | 22.7 | 24.1 | 6.2 | 3.5 | 61.8 |
| 9/13/03 | 9:45 | O | 7.59 | 78.4 | 17.1 | 17 | 6.09 | 1.88 | 127.4 |

**2003 VRAP Ashuelot River Additional Parameters**
**16-Ash, Cresson Bridge, Swanzey, NH**

| Date | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|
| **Standard*** | **NA** | **<406** | **<126** | **NA** |
| 5/17/03 | 10:51 | | | 0.028 |
| 6/28/03 | 10:30 | 210 | | 0.089 |
| 7/26/03 | 10:00 | 135 | | 0.097 |
| 8/16/03 | 10:04 | 78 | 130 | 0.031 |
| 9/13/03 | 9:45 | 77 | 93 | 0.094 |

**2003 VRAP Ashuelot River Baseline Parameters**
**15-Ash, Thompson Bridge, West Swanzey, NH**

| Date | Time of Sample | Weather | DO (mg/L) | DO (% sat.) | H2O Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) |
|---|---|---|---|---|---|---|---|---|---|
| **Standard*** | **NA** | **NA** | **>5.0** | **>75% Daily Average** | **Narrative** | **NA** | **6.5-8.0** | **<10 NTU above backgrd** | **NA** |
| 5/17/03 | 10:55 | PC | 9.57 | 91.6 | 13.3 | 16 | 6.58 | 0.8 | 101.1 |
| 6/28/03 | 10:35 | PC | 6.43 | 76.6 | 24 | 22.3 | 6.53 | 1.4 | 138.3 |
| 7/26/03 | 10:42 | C | 6.91 | 82.2 | 23.4 | 23.6 | 6.46 | 2 | 147.6 |
| 8/16/03 | 10:24 | PC | 7.4 | 87.2 | 23.8 | 25.5 | 5.79 | 4.9 | 59.3 |
| 9/13/03 | 10:55 | O | 7.56 | 79.9 | 18.1 | 20.1 | 6.53 | 1.9 | 156.7 |

**2003 VRAP Ashuelot River Additional Parameters**
**15-Ash, Thompson Bridge, West Swanzey, NH**

| Date | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|
| **Standard*** | **NA** | **<406** | **<126** | **NA** |
| 5/17/03 | 10:55 | | | 0.035 |
| 6/28/03 | 10:35 | 185 | | 0.108 |
| 7/26/03 | 10:42 | 65 | | 0.092 |
| 8/16/03 | 10:24 | 66 | 93 | 0.038 |
| | | | | |

| | | | | |
|---|---|---|---|---|
| 9/13/03 | 10:55 | 102 | 76 | 0.13 |

**2003 VRAP Ashuelot River Baseline Parameters**
**07-Ash, Route 119, Winchester, NH**

| Date | Time of Sample | Weather | DO (mg/L) | DO (% sat.) | H2O Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) |
|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75% Daily Average | Narrative | NA | 6.5-8.0 | <10 NTU above backgrd | NA |
| 5/17/03 | 9:50 | PC | 9.37 | 89.4 | 13.2 | 13.6 | 6.52 | 1.6 | 99.6 |
| 6/28/03 | 9:43 | PC | 6.78 | 80.1 | 23.9 | 23.3 | 6.67 | 1.5 | 118.1 |
| 7/26/03 | 9:42 | C | 8.37 | 97.3 | 22.6 | 23.3 | 6.67 | 0.75 | 158.9 |
| 8/16/03 | 9:46 | PC | 7.3 | 85.7 | 23.3 | 24.1 | 5.94 | 3.2 | 60.8 |
| 9/13/03 | 10:00 | O | 7.97 | 83.9 | 17.3 | 15.3 | 5.9 | 1.09 | 133.9 |

**2003 VRAP Ashuelot River Additional Parameters**
**07-Ash, Route 119, Winchester, NH**

| Date | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|
| Standard* | NA | <406 | <126 | NA |
| 5/17/03 | 9:50 | | | 0.041 |
| 6/28/03 | 9:43 | 70 | | 0.05 |
| 7/26/03 | 9:42 | 109 | | 0.082 |
| 8/16/03 | 9:46 | 46 | 71 | 0.042 |
| 9/13/03 | 10:00 | 24 | 49 | 0.068 |

**2003 VRAP Ashuelot River Baseline Parameters**
***01-Ash, 147 River Street, Hinsdale, NH***

| Date | Time of Sample | Weather | DO (mg/L) | DO (% sat.) | H2O Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) |
|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | NA | >5.0 | >75% Daily Average | Narrative | NA | 6.5-8.0 | <10 NTU above | NA |

| | | | | | | | | backgrd | |
|---|---|---|---|---|---|---|---|---|---|
| 5/17/03 | 8:50 | PC | 10.74 | 101.5 | 12.8 | 10.4 | 7.23 | 1.2 | 96.4 |
| 6/28/03 | 8:43 | PC | 7.88 | 92.5 | 23.4 | 21.8 | 7.36 | 1 | 118 |
| 7/26/03 | 8:25 | C | 8.4 | 97.5 | 22.4 | 21 | 6.93 | 1.1 | 148.8 |
| 8/16/03 | 8:41 | PC | 8.09 | 94.5 | 22.9 | 22.9 | 6.3 | 4.5 | 60.1 |
| 9/13/03 | 7:52 | O | 9.09 | 94.8 | 17.4 | 15.8 | 6.26 | 1.02 | 128.1 |

**2003 VRAP Ashuelot River Additional Parameters**

**01-Ash, 147 River Street, Hinsdale, NH**

| Date | Time of Sample | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|
| **Standard*** | **NA** | **<406** | **<126** | **NA** |
| 5/17/03 | 8:50 | | | 0.023 |
| 6/28/03 | 8:43 | 73 | | 0.045 |
| 7/26/03 | 8:25 | 69 | | 0.068 |
| 8/16/03 | 8:41 | 66 | 69 | 0.046 |
| 9/13/03 | 7:52 | 80 | 71 | 0.041 |

**New Hampshire Volunteer River Assessment Program**

**2004**

# ASHUELOT RIVER

# WATER QUALITY REPORT

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

FEBRUARY 2005

NHDES-WD-05-03

# STATE OF NEW HAMPSHIRE

## Volunteer River Assessment Program

## 2004

## ASHUELOT RIVER

## Water Quality Report

*STATE OF NEW HAMPSHIRE*
*DEPARTMENT OF ENVIRONMENTAL SERVICES*
*P.O. BOX 95*
*29 HAZEN DRIVE*
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**2004 Ashuelot River Volunteers**

Barbara Skuly
Stephen Poole
Stacie Miller
John Parsons
Jay Smeltz
Beth Caldwell
Al David
Lisa Grashow
Gary Grashow
Pat Eggleston
Roger Sweet
Ann Sweet
Fred Peters
Barbara Fostyck
Jim Holley
Jim Beatty
Steve Steppenuck
Pablo Fleischmann
Laurie Lamothe

# 1. INTRODUCTION

## 1.1. Purpose of Report

Each year NHDES prepares and distributes a water quality report for each volunteer group that is based solely on the water quality data collected by that volunteer group during a specific year. The reports summarize and interpret the data, particularly as they relate to New Hampshire surface water quality standards, and serve as a teaching tool and guidance document for future monitoring activities by the individual volunteer groups. The purpose of this report is to present the data collected by the Ashuelot River VRAP volunteers in 2004.

## 1.2. Report Format

Each report includes the following:

- ✓ **Volunteers River Assessment Program (VRAP) Overview:** This section includes a discussion of the history of VRAP, the technical support, training and guidance provided by NHDES, and how data is transmitted to the volunteers and used in surface water quality assessments.

- ✓ **Water Quality Parameters Typically Selected for Monitoring**: This section includes a brief discussion of water quality parameters typically sampled by volunteers and their importance, as well as applicable state water quality criteria or levels of concern.

- ✓ **Monitoring Program Description**: A description of the volunteer group's monitoring program is provided in this section including monitoring objectives as well as a table and map showing sample station locations.

- ✓ **Results and Discussion:** Water quality data collected during the year are summarized on a parameter-by-parameter basis using (1) a summary table that includes the number of samples collected, data ranges, the number of samples meeting New Hampshire water quality standards, and the number of samples adequate for water quality assessments at each station, (2) a discussion of the data, (3) a list of applicable recommendations, and (4) a river graph showing the range of measured values at each station. Sample results reported as less than the detection limit were assumed equal to one-half the detection limit on the river graphs. This approach simplifies the understanding of the parameter of interest, and specifically helps one to visualize how the river or watershed is functioning from upstream to downstream. In addition, this format allows the reader to better understand potential pollution areas and target those areas for additional sampling or environmental enhancements. Where applicable, the river graph also shows New Hampshire surface water quality standards or levels of concern for comparison purposes.

- ✓ **Appendix – Data:** The appendix includes a spreadsheet showing the data results and additional information, such as data results which do not meet New Hampshire surface water quality standards, and data that is unusable for assessment purposes due to quality control requirements.

# 2. VOLUNTEER RIVER ASSESSMENT PROGRAM OVERVIEW

## 2.1. Past, Present, and Future

In 1998, the New Hampshire Department of Environmental Services (DES) initiated the New Hampshire Volunteer River Assessment Program (VRAP) as a means of expanding public education of water resources in New Hampshire. VRAP promotes education and awareness of the importance of maintaining water quality in rivers and streams. VRAP was created in the wake of the success of the existing New Hampshire Volunteer Lake Assessment Program (VLAP), which provides educational and stewardship opportunities pertaining to lakes and ponds to New Hampshire's residents.

Today, VRAP continues to serve the public by providing water quality monitoring equipment, technical support, and educational programs. VRAP supports over a dozen volunteer groups on numerous rivers and watersheds throughout the state. These volunteer groups conduct water quality monitoring on an ongoing basis. The work of the VRAP volunteers increases the amount of river water quality information available to local, state and federal governments, which allows for effective financial resource allocation and watershed planning.

The intent of VRAP is to educate people of all ages and backgrounds about river and stream water quality, the threats to water quality posed by increasing population, development and industrialization, and the ways in which we can all work together to minimize these impacts.

## 2.2. Technical Support

VRAP lends and maintains water quality monitoring kits to volunteer groups throughout the state. The kits contain electronic meters and supplies for "in-the-field" measurements of water temperature, dissolved oxygen, pH, specific conductance (conductivity), and turbidity. These are the core parameters typically measured by volunteers. However, other water quality parameters such as nutrients, metals, and *E. coli* can also be studied by volunteer groups, although VRAP does not always provide funds to cover laboratory analysis costs. Thus, VRAP encourages volunteer groups to pursue other fundraising activities such as association membership fees, special events, in-kind services (non-monetary contributions from individuals and organizations), and grant writing.

VRAP typically recommends sampling every other week during the summer, and citizen-monitoring groups are encouraged to organize a long-term sampling program in order to begin to determine trends in river conditions. Each year volunteers arrange a sampling schedule and design in cooperation with the VRAP Coordinator. Project designs are created through a review and discussion of existing water quality information, such as known and perceived problem areas or locations of exceptional water quality. The interests, priorities, and resources of the partnership determine monitoring locations, parameters, and frequency.

Water quality measurements repeated over time create a picture of the fluctuating conditions in rivers and streams and help to determine where improvements, restoration or preservation may benefit the river and the communities it supports. Water quality results are also used to determine if a river is meeting surface water quality standards. Volunteer monitoring results, meeting DES Quality Assurance and Quality Control (QA/QC) requirements, supplement the efforts of DES to assess the condition of New Hampshire surface waters. The New Hampshire Surface Water Quality Regulations are available through the DES Public Information Center at www.des.state.nh.us/wmb/Env-Ws1700.pdf or (603) 271-1975.

## 2.3. Training and Guidance

Each VRAP volunteer must attend an annual training session to receive a demonstration of monitoring protocols and sampling techniques. Training sessions are an opportunity for volunteers to come together and receive an updated version of monitoring techniques. During the training, volunteers have a chance to practice using the VRAP equipment and may also receive instruction in the collection of samples for laboratory analysis. Training is accomplished in approximately three hours, after which volunteers are certified in the care, calibration, and use of the VRAP equipment.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. VRAP aims to visit volunteers during scheduled sampling events to verify that volunteers successfully follow the VRAP protocols. If necessary, volunteers are re-trained during the visit, and the group's monitoring coordinator is notified of the result of the verification visit. Volunteer organizations forward water quality results to the VRAP Coordinator for incorporation into an annual report and state water quality assessment activities.

## 2.4. Data Usage

### 2.4.1. Public Outreach/Water Quality Reports

All data collected by volunteers are summarized in water quality reports that are prepared and distributed after the conclusion of the sampling period (typically fall or winter). Each volunteer group receives copies of the report. The volunteers can use the reports and data as a means of understanding the details of water quality, guiding future sampling efforts, or determining restoration activities.

### 2.4.2. State Surface Water Quality Assessments

Along with data collected from other water quality programs, specifically the State Ambient River Monitoring Program, applicable volunteer data are used to support periodic DES surface water quality assessments. VRAP data are entered into NHDES's Environmental Monitoring Database and are ultimately uploaded to the Environmental Protection Agency's database, STORET. Assessment results and the methodology used to assess surface waters are published by DES every two years (i.e., Section 305(b) Water Quality Reports) as required by the federal Clean Water Act. The reader is encouraged to log on to the DES web page to review the assessment methodology and list of impaired waters http://www.des.state.nh.us/wmb/swqa/.

## 2.5. Quality Assurance/Quality Control

In order for VRAP data to be used in the assessment of New Hampshire's surface waters, the data must meet quality control guidelines as outlined in the VRAP Quality Assurance Project Plan (QAPP). The VRAP QAPP was approved by NHDES and reviewed by EPA in the summer of 2003. The QAPP is reviewed annually and is officially updated and approved every five years. The VRAP Quality Assurance/Quality Control (QA/QC) measures include a six-step approach to ensuring the accuracy of the equipment and consistency in sampling efforts.

- **Calibration**: All meters are calibrated before the first measurement and after the last one. Prior to each measurement, the pH and dissolved oxygen meters are calibrated.
- **Replicate Analysis**: A second measurement by each meter is taken from the original sample at one of the stations during the sampling day. The replicate analysis should not be conducted at the same station over and over again, but should be conducted at different stations throughout the monitoring season.
- **6.0 pH Standard**: A reading of the pH 6.0 buffer is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the 6.0 pH standard check should be conducted at different stations.
- **Zero Oxygen Standard**: A reading of a zero oxygen solution is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the zero oxygen standard check should be conducted at different stations.
- **DI Turbidity Blank**: A reading of the DI blank is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the blank check should be conducted at different stations.
- **Post-Calibration**: At the conclusion of each sampling day, all meters are calibrated.

## 2.5.1. Measurement Performance Criteria

Precision is calculated for field and laboratory measurements through measurement replicates (instrumental variability) and is calculated for each sampling day. The use of VRAP data for assessment purposes is contingent on compliance with a parameter-specific relative percent difference (RPD) as derived from equation 1, below. Any data exceeding the limits of the individual measures are disqualified from surface water quality assessments. All data that exceeds the limits defined by the VRAP QAPP are acknowledged in the data tables with an explanation of why the data was unusable. Table 2-1 shows typical parameters studied under VRAP and the associated quality control procedures.

(Equation 1)

$$RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100 \ \%$$

where $x_1$ is the original sample and $x_2$ is the replicate sample

**Table 2- 1. Field Analytical Quality Controls**

| Water Quality Parameter | QC Check | QC Acceptance Limit | Corrective Action | Person Responsible for Corrective Action | Data Quality Indicator |
|---|---|---|---|---|---|
| Temperature | Measurement replicate | ± 0.2 °C | Repeat measurement | Volunteer Monitors or Program Manager | Precision |
| Dissolved Oxygen | Measurement replicate | ± 2% of saturation, or ± 0.2 mg/L | Recalibrate instrument, repeat measurement | Volunteer Monitors or Program Manager | Precision |
| | Known buffer (zero oxygen solution) | <0.5 mg/L | Recalibrate instrument, repeat measurement | Volunteer Monitors or Program Manager | Relative accuracy |
| pH | Measurement replicate | ± 0.1 std units | Recalibrate instrument, repeat measurement | Volunteer Monitors or Program Manager | Precision |
| | Known buffer (pH = 6.0) | ± 0.1 standard units | Recalibrate instrument repeat measurement | Volunteer Monitors or Program Manager | Accuracy |
| Specific Conductance | Measurement replicate | ± 30 µS/cm | Recalibrate instrument, repeat measurement | Volunteer Monitors or Program Manager | Precision |
| | Method blank | ± 5.0 µS/cm | Recalibrate instrument, repeat measurement | Volunteer Monitors or Program Manager | Accuracy |
| Turbidity | Measurement replicate | ± 0.1 NTU | Recalibrate instrument, repeat measurement | Volunteer Monitors or Program Manager | Precision |
| | Method blank | ± 0.1 NTU | Recalibrate instrument, repeat measurement | Volunteer Monitors or Program Manager | Accuracy |

# 3. WATER QUALITY PARAMETERS TYPICALLY MEASURED BY VRAP VOLUNTEERS

## 3.1. Temperature

Water temperature is one of the most important and commonly observed water quality parameters. Temperature influences the rate of many physical, chemical and biological processes in the aquatic environment. Each aquatic species has a range of temperature and other factors that best support its reproduction and the survival of offspring. Temperature can also impact aquatic life because of its influence on parameters such as ammonia as well as the concentration of dissolved oxygen in the water.

Temperature in Class B waters shall be in accordance with RSA 485-A:8, II which states in part "any stream temperature increase associated with the discharge of treated sewage, waste or cooling water, water diversions, or releases shall not be such as to appreciably interfere with the uses assigned to this class."

## 3.2. Dissolved Oxygen

Adequate oxygen dissolved in the water is crucial to the survival and successful reproduction of many aquatic species. Organisms such as fish use gills to transfer oxygen to their blood for vital processes that keep the fish active and healthy. Oxygen is dissolved into the water from the atmosphere, aided by wind and wave action where it tumbles over rocks and uneven stream beds. Aquatic plants and algae produce oxygen in the water, but this contribution is offset by respiration at night as well as by bacteria which utilize oxygen to decompose plants and other organic matter into smaller and smaller particles.

Oxygen concentrations in water are measured using a meter that produces readings for both milligrams per liter (mg/L) and percent (%) saturation of dissolved oxygen. For Class B waters, any single dissolved oxygen reading must be greater than 5 mg/L for the water to meet New Hampshire water quality standards. This means that in every liter of water there must be at least five milligrams of dissolved oxygen available for ecosystem processes.

More than one measurement of oxygen saturation taken in a twenty-four hour period can be averaged to compare to the standards. Class B waters must have a dissolved oxygen content of not less than 75% of saturation, based on a daily average. The concentration of dissolved oxygen is dependent on many factors including temperature and sunlight, and tends to fluctuate throughout the day. Saturation values are averaged because a reading taken in the morning may be low due to respiration, while a measurement that afternoon may show that the percent saturation has recovered to acceptable levels. Water can become saturated with more than 100% dissolved oxygen. It should be noted that other dissolved oxygen requirements in the New Hampshire Surface Water Quality

Regulations (Env-Ws 1700) pertain to cold water fish spawning areas, impoundments (dams), and reservoirs.

## 3.3. pH

pH is a measure of hydrogen ion activity in water. The lower the pH, the more acidic the solution due to higher concentrations of hydrogen ions. A high pH is indicative of an alkaline or basic environment. pH is measured on a logarithmic scale of 0 to 14. NH rivers typically fall within the range of pH values from 6 to 8. Most aquatic species need a pH of between 5 and 9. pH also affects the toxicity of other aquatic compounds such as ammonia and certain metals.

New Hampshire Surface Water Quality Regulations (Env-Ws 1700) state that pH shall be between 6.5 and 8, unless naturally occurring. Readings that fall outside this range may be due to natural conditions such as the influence of wetlands near the sample station or because of the soils and bedrock in the area. Tannic and humic acids released to the water by decaying plants, for example, can create more acidic waters in areas influenced by wetlands. Low pH can also be due to atmospheric deposition of chemicals emitted by sources such as fossil fuel power plants and car emissions. When it rains, the chemicals in the atmosphere can lower the pH of the rain (commonly referred to as "acid rain"), which can, in turn, lower the pH of the river or stream. Acid rain typically has a pH of 3.5 to 5.5.

## 3.4. Specific Conductance

Specific conductance (informally termed conductivity) is the numerical expression of the ability of water to carry an electric current, and is a measure of the free ion content in the water. Water contains ions (charged particles) which can come from natural sources such as bedrock, or be introduced by human activity. The free ions carry an electrical current. Conductivity can be used to indicate the presence of chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, iron, and aluminum ions.

There is no numeric standard for conductivity because levels naturally vary a great deal according to the geology of an area. Conductivity readings are useful for screening an area to determine potential pollution sources.

## 3.5. Turbidity

Turbidity is an indicator of the amount of suspended material in the water, such as clay, silt, algae, suspended sediment, and decaying plant material. A high degree of turbidity can scatter the passage of light through the water, and inhibit light from reaching important areas. Clean waters are generally associated with low turbidity, but there is a high degree of natural variability involved. Rain events often contribute turbidity to surface waters by flushing sediment, organic matter and other materials from the surrounding landscape into surface waters. According to New Hampshire's Surface Water Quality

Regulations (Env-Ws 1700), Class B waters shall not exceed naturally occurring conditions by more than 10 Nephelometric Turbidity Units (NTU).

## 3.6. Bacteria

Organisms causing infections or disease (pathogens) are often excreted in the fecal material of humans and other warm-blooded animals. *Escherichia coli* (*E. coli*) bacteria is not considered pathogenic. *E. coli* is, however, almost universally found in the intestinal tracts of humans and warm blooded animals and is relatively easy and inexpensive to measure. For these reasons *E. coli* is used as an indicator of fecal pollution and the possible presence of pathogenic organisms.

In fresh water, *E. coli* concentrations help determine if the water is safe for recreational uses such as swimming. According to New Hampshire's surface water quality standards, Class B waters shall contain not more than either a geometric mean based on at least three samples obtained over a sixty-day period of 126 *E. coli* per one hundred milliliters (CTS/100mL), or greater than 406 *E. coli* CTS/100mL in any one sample.

## 3.7. Total Phosphorus

Phosphorus is a nutrient that is essential to plants and animals, however, in excess amounts it can cause rapid increases in the biological activity in water. This may disrupt the ecological integrity of streams and rivers.

Phosphate is the form of phosphorus that is readily available for use by aquatic plants. Phosphate is usually the limiting nutrient in freshwater streams, which means relatively small amounts of phosphate can have a large impact on the biological activity in the water. Excess phosphorus can trigger nuisance algal blooms and aquatic plant growth, which can decrease oxygen levels and the attractiveness of waters for recreational purposes.

Phosphorus can be an indicator of sewage, animal manure, fertilizer, erosion, and other types of contamination. There is no numeric surface water quality standard for phosphorus due to the high degree of natural variability and the difficulty of pinpointing the exact source. However 0.05 mg/L total phosphorus is typically used as a level of concern, which means DES pays particular attention to readings above this level.

## 3.8. Metals

Depending on the metal concentration, its form (dissolved or particulate) and the hardness of the water, trace metals can be toxic to aquatic life. Metals in dissolved form are generally more toxic than metals in the particulate form. The dissolved metal concentration is dependent on the pH of the water, as well as the presence of solids and organic matter that can bind with the metal to render it less toxic. Hardness is primarily a measure of the calcium and magnesium ion concentrations in water, expressed as calcium carbonate. The hardness concentration affects the toxicity of certain metals. Numeric criteria for metals may be found in New Hampshire's Surface Water Quality Regulations (Env-Ws 1700).

# 4. MONITORING PROGRAM DESCRIPTION

During the summer of 2001, volunteers from the Ashuelot River Local Advisory Committee began water quality monitoring on the river in conjunction with NHDES's Volunteer River Assessment Program. This effort provides water quality data from the Ashuelot River relative to surface water quality standards. In addition, the ongoing effort allows for an understanding of the river's dynamics, or variations on a station-by-station and year-to-year basis. The data can also serve as a baseline from which to determine any water pollution problems in the river and/or watershed. The Volunteer River Assessment Program has provided field training, funding, equipment, and technical assistance.

Ten stations along the mainstem of the Ashuelot River were monitored in 2004 from its upper limits in Washington to just upstream of its confluence with the Connecticut River in Hinsdale. Sampling station descriptions are provided in Table 4-1 and locations are shown on the foldout map on the following page.

**Table 4-1. Sampling stations for the Ashuelot River, NHDES VRAP, 2004**

| Station ID | Location | Town | Elevation* |
|---|---|---|---|
| 28-ASH | Route 31 | Washington | 1600 |
| 27-ASH | Mountain Road | Lempster | 1500 |
| 24A-ASH | Route 10 | Marlow | 1100 |
| 23-ASH | Route 10 | Gilsum | 800 |
| 20A-ASH | Stone Arch Bridge | Keene | 500 |
| 18-ASH | Route 101 | Keene | 500 |
| 16-ASH | Cresson Bridge | Swanzey | 500 |
| 15-ASH | Thompson Bridge | West Swanzey | 400 |
| 07-ASH | Route 119 | Winchester | 400 |
| 01-ASH | 147 River Street | Hinsdale | 200 |

*Elevations have been rounded off to 100-foot increments for purposes of calibrating the dissolved oxygen meter.

# 5. RESULTS AND DISCUSSION

## 5.1. Dissolved Oxygen

### 5.1.1. Results and Discussion

Five measurements were taken in the field for dissolved oxygen concentration at 10 stations on the mainstem of the Ashuelot River from Washington to Hinsdale [Table 5-1]. Of the 50 measurements taken, 47 met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

The Class B New Hampshire surface water quality standard for dissolved oxygen includes a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be assessed as meeting dissolved oxygen standards.

**Table 5-1. Dissolved Oxygen Data Summary, Ashuelot River 2004, VRAP**

| Station ID | Samples Collected | Data Range (mg/l) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 5 | 6.87 - 8.04 | 0 | 5 |
| 27-ASH | 5 | 7.03 - 8.37 | 0 | 5 |
| 24A-ASH | 5 | 7.38 - 8.16 | 0 | 5 |
| 23-ASH | 5 | 7.87 - 9.22 | 0 | 5 |
| 20A-ASH | 5 | 7.39 - 8.40 | 0 | 5 |
| 18-ASH | 5 | 7.35 - 8.43 | 0 | 5 |
| 16-ASH | 5 | 7.26 - 8.25 | 0 | 5 |
| 15-ASH | 5 | 6.30 - 7.21 | 0 | 4[a] |
| 07-ASH | 5 | 6.96 - 7.40 | 0 | 4[a] |
| 01-ASH | 5 | 7.95 - 8.67 | 0 | 4[a] |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **47** |

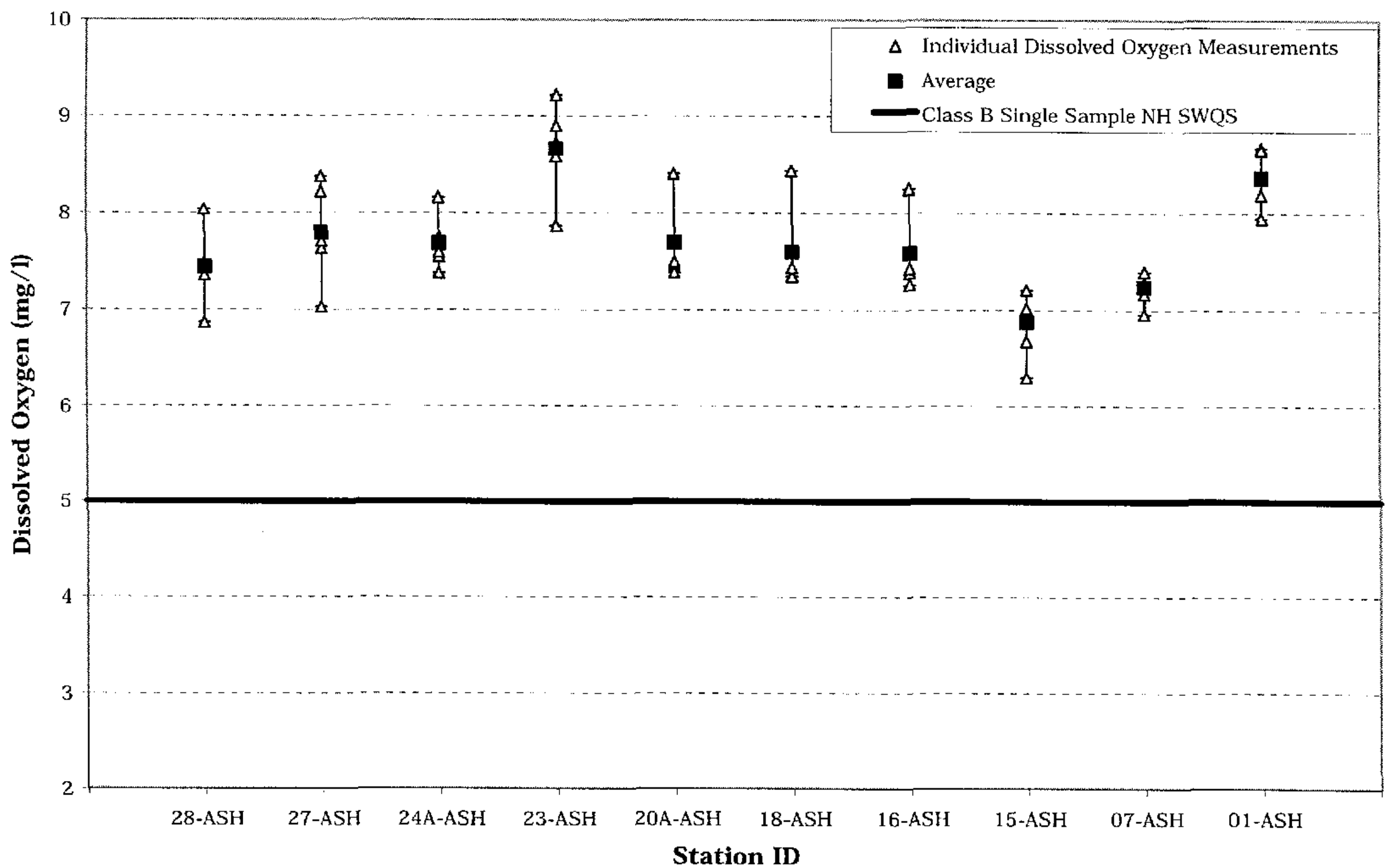
**[a]Relative % differences of replicate exceeded standard in QAPP on 5/22/04**

Dissolved oxygen concentration levels were above state standards on all occasions and at all stations (Figure 5-1). The average concentration of dissolved oxygen was consistently above the Class B standard at all stations ranging from 6.9 mg/L to 8.7 mg/L. Levels of dissolved oxygen sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions.

### 5.1.2. Recommendations

- Continue sampling at all stations to develop a long-term data set to better understand trends as time goes on.
- If possible, take measurements between 5:00 a.m. and 10:00 a.m., which is when dissolved oxygen is usually the lowest, and between 2:00 p.m. and 7:00 p.m. when dissolved oxygen is usually the highest.
- Incorporate the use of submersible meters to automatically record dissolved oxygen saturation levels during a period of several days. This could be done by using a Hydrolab® DataSonde 4a multiprobe, which is an instrument that can collect data at specific time intervals (e.g., every 15 minutes). The instrument can be put in the stream and left alone for a period of several days. The use of these instruments is dependent upon availability, and requires coordination with DES.

**Figure 5-1. Dissolved Oxygen Statistics for the Ashuelot River, New Hampshire, May 22 - September 18, 2004, NHDES VRAP**



## 5.2. pH

### 5.2.1. Results and Discussion

Five measurements were taken in the field for pH at 10 stations on the mainstem of the Ashuelot River from Washington to Hinsdale [Table 5-2]. Of the 50 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

The Class B New Hampshire surface water quality standard for pH is 6.5 - 8.0, unless naturally occurring.

**Table 5-2. pH Data Summary, Ashuelot River 2004, VRAP**

| Station ID | Samples Collected | Data Range (standard units) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 5 | 5.84 - 6.14 | 5 | 5 |
| 27-ASH | 5 | 5.68 - 5.94 | 5 | 5 |
| 24A-ASH | 5 | 5.79 - 6.57 | 4 | 5 |
| 23-ASH | 5 | 6.21 - 6.41 | 5 | 5 |
| 20A-ASH | 5 | 6.36 - 6.55 | 3 | 5 |
| 18-ASH | 5 | 6.40 - 6.47 | 5 | 5 |
| 16-ASH | 5 | 6.39 - 6.61 | 3 | 5 |
| 15-ASH | 5 | 6.31 - 6.49 | 3 | 5 |
| 07-ASH | 5 | 6.15 - 6.65 | 3 | 5 |
| 01-ASH | 5 | 6.53 - 6.86 | 0 | 5 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **50** |

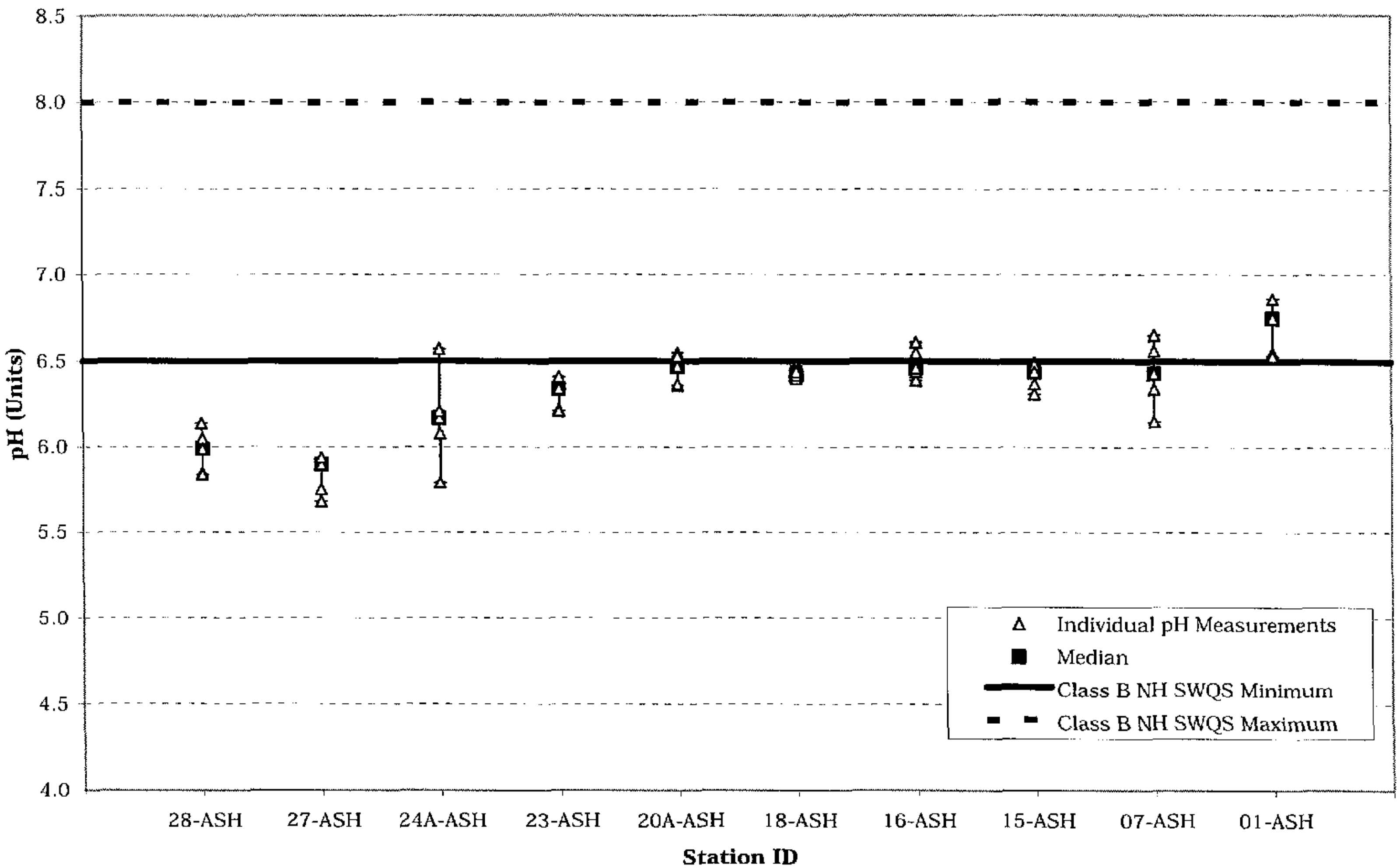
The pH levels in the upper reaches of the river (i.e., Washington to Marlow) were on most occasions, outside of the range of the New Hampshire surface water quality standard (Figure 5-2). This is likely the result of natural conditions such as the soils, geology, or the presence of wetlands in the area. It should be noted that rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels.

The pH levels in other reaches of the river downstream from Marlow were variable, both within and outside of the range of the New Hampshire surface water quality standard. In general, pH increased downstream from Keene to Hinsdale. The pattern of increasing pH may be the result of a greater number of cations (positively charge elements such as sodium and calcium), which typically increase in urbanized areas. This can be related to the increased specific conductance levels found in this reach of the river (see Section 5.4).

### 5.2.2. Recommendations

- Continue sampling at all stations; this will help to build a long-term data set to better understand trends as time goes on.
- Consider sampling for pH in some of the tributaries and wetland areas that are influencing the pH of stations with measurements below state standards. Site conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes.* Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.

**Figure 5-2. pH Statistics for the Ashuelot River, New Hampshire, May 22 - September 18, 2004, NHDES VRAP**



## 5.3. Turbidity

### 5.3.1. Results and Discussion

Five measurements were taken in the field for turbidity at 10 stations on the mainstem of the Ashuelot River from Washington to Hinsdale [Table 5-3]. Of the 50 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency. The Class B New Hampshire surface water quality standard for turbidity is less than 10 NTU above background.

**Table 5-3 Turbidity Data Summary for the Ashuelot River 2004, VRAP**

| Station ID | Samples Collected | Data Range (NTU) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 5 | 0.4 - 0.65 | 0 | 5 |
| 27-ASH | 5 | 0.2 - 3.6 | 0 | 5 |
| 24A-ASH | 5 | 0.1 - 0.6 | 0 | 5 |
| 23-ASH | 5 | 0.1 - 6.8 | 0 | 5 |
| 20A-ASH | 5 | 0.6 - 3.1 | 0 | 5 |
| 18-ASH | 5 | 1.0 - 3.6 | 0 | 5 |
| 16-ASH | 5 | 1.5 - 13.0 | 0 | 5 |
| 15-ASH | 5 | 1.4 - 4.7 | 0 | 5 |
| 07-ASH | 5 | 1.3 - 3.8 | 0 | 5 |
| 01-ASH | 5 | 1.0 - 3.0 | 0 | 5 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **50** |

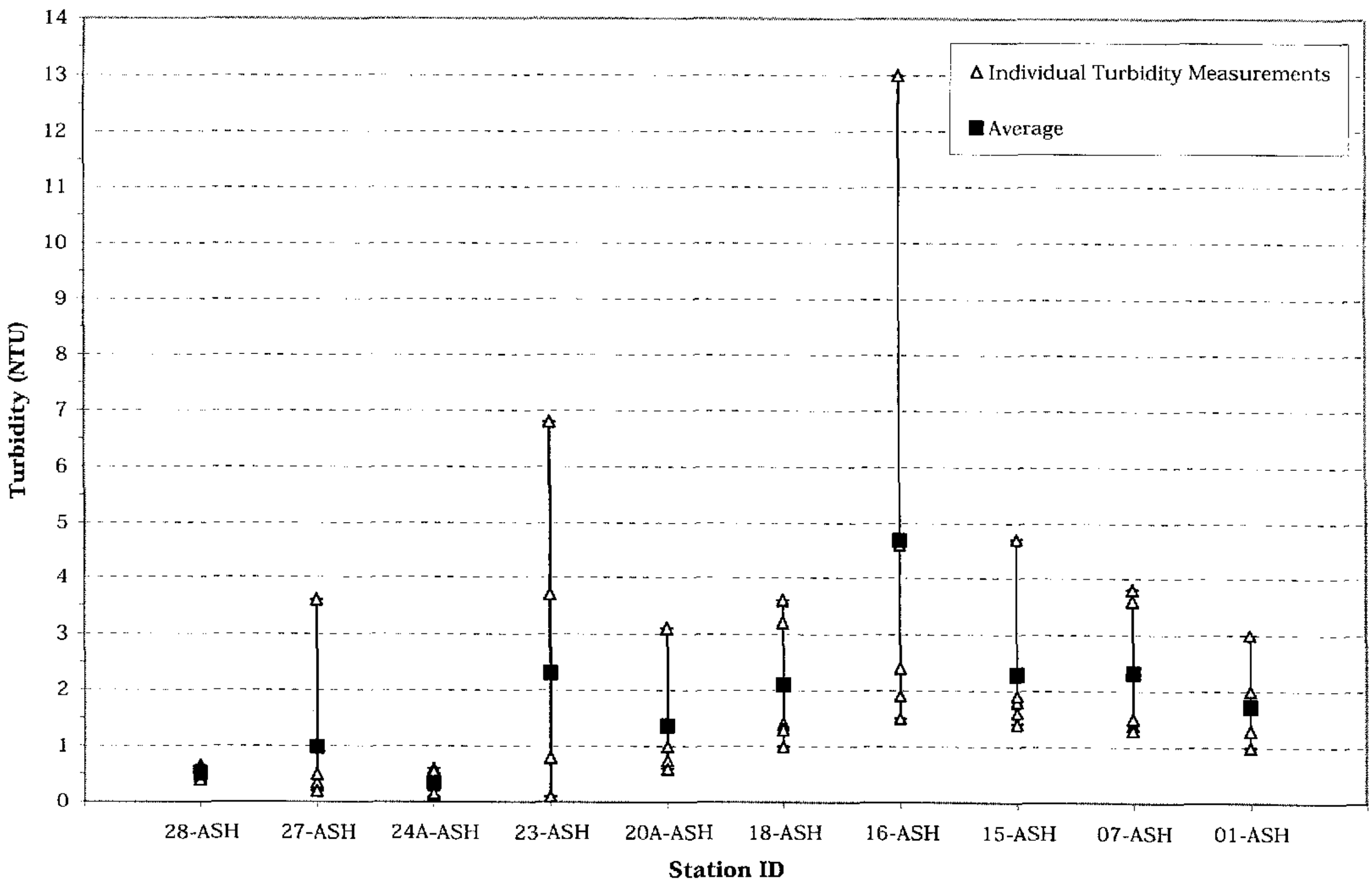
Turbidity levels were low on all occasions and at all stations with the average ranging from 0.3 NTU to 4.7 NTU (Figure 5-3). Although clean waters are associated with low turbidity there is a high degree of natural variability involved. Precipitation often contributes to increased turbidity by flushing sediment, organic matter and other materials from the surrounding landscape into surface waters. However, human activities such as removal of vegetation near surface waters and disruption of nearby soils can lead to dramatic increases in turbidity levels.

In general it is typical to see a rise in turbidity in more developed areas due to increased runoff. Figure 5-3 shows a slight increase in turbidity averages as one moves downstream towards the more developed areas near Keene. Turbidity levels during 2004 will be a useful indicator of the typical background conditions of the river.

### 5.3.2. Recommendations

- Continue sampling at all stations as this will help to build a long-term data set to better understand trends as time goes on.
- Collect samples during wet weather; this will help us to understand how the river responds to runoff and sedimentation.
- If a higher than normal turbidity measurement occurs, volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated turbidity levels. In addition, take good field notes and photographs. If human activity is suspected or verified as the source of elevated turbidity levels volunteers should contact the VRAP coordinator so NHDES can further investigate.

**Figure 5-3. Turbidity Statistics for the Ashuelot River, New Hampshire, May 22 - September 18, 2004, NHDES VRAP**



## 5.4. Specific Conductance

### 5.4.1. Results and Discussion

Five measurements were taken in the field for specific conductance at 10 stations on the mainstem of the Ashuelot River from Washington to Hinsdale [Table 5-4]. Of the 50 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency. New Hampshire surface water quality standards do not contain numeric limits for specific conductance.

**Table 5-3 Specific Conductance Data Summary for the Ashuelot River 2004, VRAP**

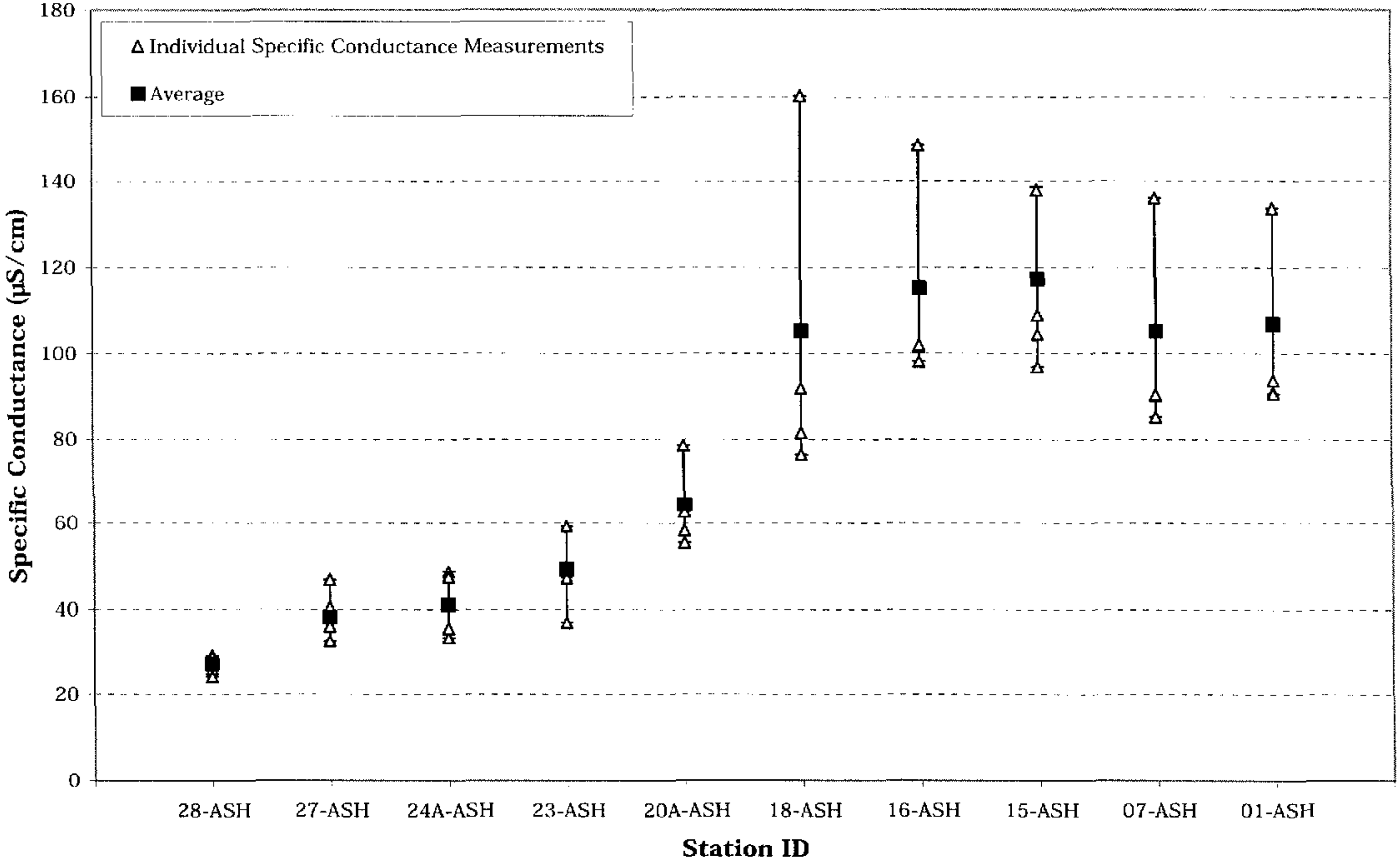
| Station ID | Samples Collected | Data Range (µS/cm) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 5 | 24.1 - 29.1 | Not Applicable | 5 |
| 27-ASH | 5 | 32.6 - 46.9 | N/A | 5 |
| 24A-ASH | 5 | 33.4 - 48.8 | N/A | 5 |
| 23-ASH | 5 | 36.9 - 59.3 | N/A | 5 |
| 20A-ASH | 5 | 55.5 - 78.5 | N/A | 5 |
| 18-ASH | 5 | 76.4 - 160.3 | N/A | 5 |
| 16-ASH | 5 | 98.1 - 148.5 | N/A | 5 |
| 15-ASH | 5 | 96.9 - 138.7 | N/A | 5 |
| 07-ASH | 5 | 85.2 - 136.1 | N/A | 5 |
| 01-ASH | 5 | 90.7 - 133.9 | N/A | 5 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **50** |

Specific conductance levels were variable along the entire reach of the river with the average ranging from 27 µs/cm (Washington) to 117 µs/cm (downstream of Keene) (Figure 5-4). The influence of urbanization on specific conductance is apparent by the increased levels from the more rural upstream areas to the more developed areas in the Keene area. Anions (negatively charged elements such as chloride) and cations (positively charged elements such as calcium) are typically found in rivers flowing through urbanized areas.

### 5.4.2. Recommendations

- Continue sampling at all stations as this will help to build a long-term data set to better understand trends as time goes on.

**Figure 5-4. Specific Conductance Statistics for the Ashuelot River, New Hampshire, May 22 - September 18, 2004, NHDES VRAP**



## 5.5. Bacteria/*Escherichia coli*

### 5.5.1. Results and Discussion

Either five or six measurements were taken in the field for *E.coli* at 10 stations on the mainstem of the Ashuelot River from Washington to Hinsdale (Table 5-5). Of the 55 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency. Class B NH surface water quality standards for *E.coli* are as follows:

<406 cts/100 ml, based on any single sample, or
<126 cts/100 ml, based on a geometric mean calculated from three samples collected within a 60-day period.

**Table 5-5 *E. coli* Data Summary for the Ashuelot River 2004, VRAP**

| Station ID | Samples Collected | Data Range (cts/100ml) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 5 | 2 - 40 | 0 | 3 |
| 27-ASH | 5 | 7 - 1460 | 1 | 3 |
| 24A-ASH | 5 | 8 - 230 | 0 | 3 |
| 23-ASH | 5 | 8 - 1250 | 2 | 4 |
| 20A-ASH | 5 | 22 - 350 | 0 | 3 |
| 18-ASH | 6 | 67 - 873 | 1 | 4 |
| 16-ASH | 6 | 52 - 1840 | 2 | 4 |
| 15-ASH | 6 | 33 - 1060 | 0 | 4 |
| 07-ASH | 6 | 30 - 770 | 2 | 4 |
| 01-ASH | 6 | 57 - 2020 | 2 | 4 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **55** |

A majority of the stations had at least one *E.coli* single sample which exceeded the New Hampshire surface water quality standard (Figure 5-5). All of the exceedances occurred during the testing done on August 21st and September 18th. According to National Weather Service preliminary data, a total of 1.8 inches of rain were recorded in Keene during the 48 hours preceding the August 21st sampling. Precipitation is one of the main factors that can lead to elevated E.coli levels due to both runoff from impervious surfaces and the flushing of wetland areas frequented by wildlife. ARLAC volunteers retested the five most downstream stations on August 30th. During the 48 hours preceding this round of testing there was no precipitation. No measurements taken on August 30th exceeded the single sample standard.

The 48-hours preceding the September 18th round of testing was extremely wet with a total of 2.6 inches of rain recorded in Keene. Seven of the ten station had E.coli measurements that exceeded the single sample standard on September 18th. Bacteria data collected during 2004 indicates that there is a strong correlation on the Ashuelot River between E.coli levels and precipitation.

In order for a geometric mean to be computed three samples must be collected within a 60-day period. If samples are spread out over multiple 60 day periods this allows DES to calculate a rolling geometric mean [Table 5-6]. As the table indicates, eight of the ten stations violated the geometric mean standard of <126 cts/100 ml.

Again, several factors can contribute to elevated *E. coli* levels, including, but not limited to rain storms, low river flows, the presence of wildlife (e.g., birds), and the presence of septic systems along the river.

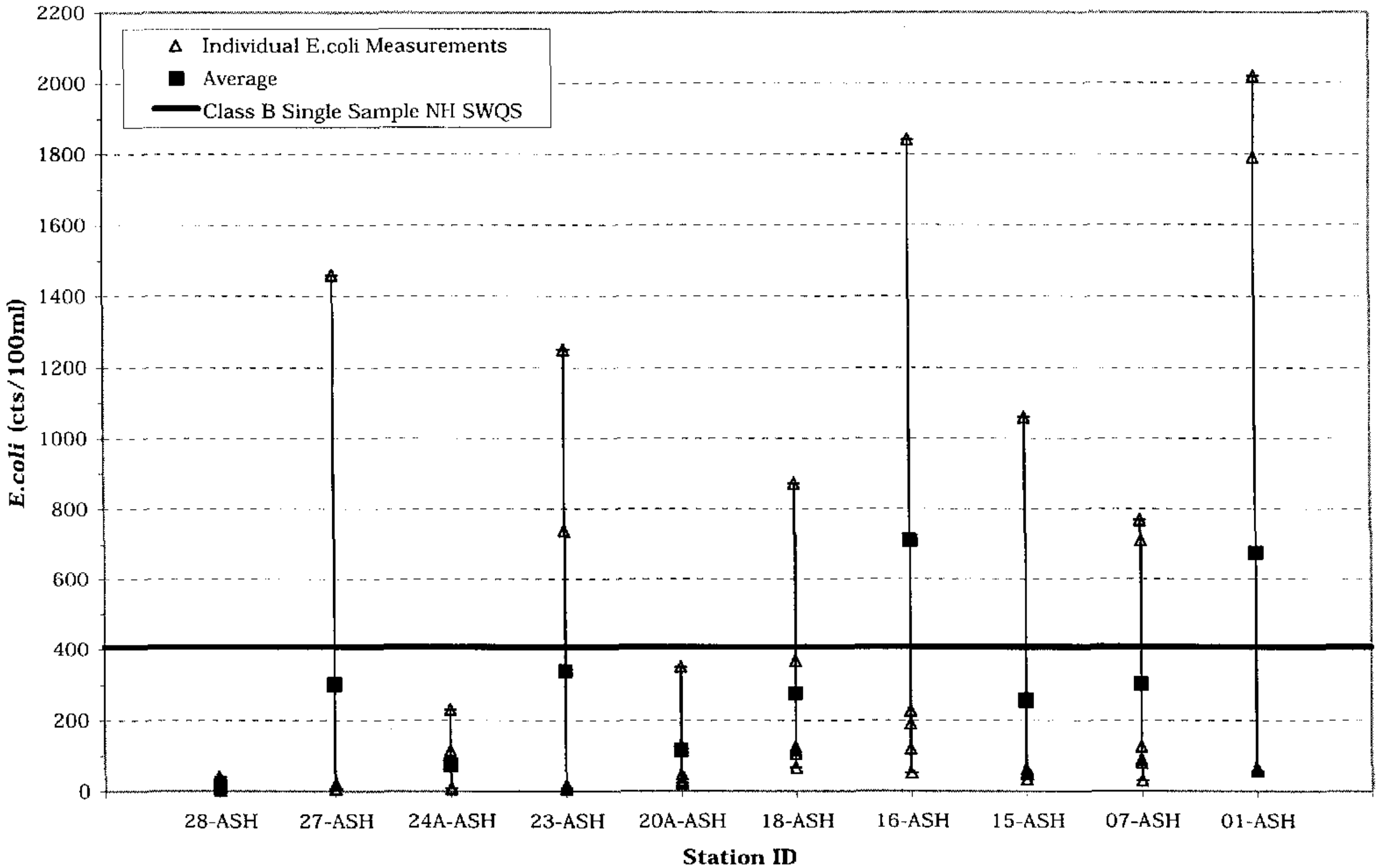
**Table 5-6 Geometric means for *E. coli* data, Ashuelot River 2004, VRAP**

| Station ID | Geometric Mean 5/22/04 - 7/17/04 | Geometric Mean 7/17/04 - 8/30/04 | Geometric Mean 7/26/03 - 9/13/03 | Geometric Means Not Meeting NH Class B Standards |
|---|---|---|---|---|
| 28-ASH | 3 | NA | NA | 0 |
| 27-ASH | 7 | NA | NA | 0 |
| 24A-ASH | 9 | NA | NA | 0 |
| 23-ASH | 10 | 54 | 246 | 1 |
| 20A-ASH | 32 | NA | NA | 0 |
| 18-ASH | 96 | 176 | 335 | 2 |
| 16-ASH | 112 | 430 | 863 | 2 |
| 15-ASH | 55 | 76 | 211 | 1 |
| 07-ASH | 97 | 128 | 254 | 2 |
| 01-ASH | 61 | 186 | 601 | 2 |

### 5.5.2. Recommendations

- Continue collecting three samples within a 60-day period during the summer to allow for determination of geometric means.
- Continue to document river conditions and station characteristics (including the presence of wildlife in the area during sampling).
- At stations with particularly high bacteria levels volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated bacteria levels. Those sampling should also look for any potential sources of bacteria such as emission pipes and failed septic systems.
- NHDES and the VRAP program may have funds available to do more targeted bacteria sampling at those stations that have had chronic problems. Coordinate with VRAP to determine where this sampling should take place and under what weather conditions.

**Figure 5-5. *Escherichia coli* Statistics for the Ashuelot River, New Hampshire, May 22 - September 18, 2004, NHDES VRAP**



## 5.6. Total Phosphorus

### 5.6.1. Results and Discussion

Five measurements were taken in the field for total phosphorous at 10 stations on the mainstem of the Ashuelot River from Washington to Hinsdale (Table 5-7). Of the 50 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2004 surface water quality report to the Environmental Protection Agency. A numeric Class B NH surface water quality standard does not exist for total phosphorus. However, a total phosphorus concentration of 0.05 mg/L is used by NHDES as a level of concern and the agency pays particular attention to results above this level.

**Table 5-7 Total Phosphorous Data Summary for the Ashuelot River 2004, VRAP**

| Station ID | Samples Collected | Data Range (mg/L) | Acceptable Samples Exceeding NHDES Level of Concern | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 5 | 0.005 - 0.008 | 0 | 5 |
| 27-ASH | 5 | 0.006 - 0.017 | 0 | 5 |
| 24A-ASH | 5 | 0.007 - 0.013 | 0 | 5 |
| 23-ASH | 5 | 0.0028 - 0.042 | 0 | 5 |
| 20A-ASH | 5 | 0.007 - 0.019 | 0 | 5 |
| 18-ASH | 5 | 0.012 - 0.022 | 0 | 5 |
| 16-ASH | 5 | 0.039 - 0.091 | 3 | 5 |
| 15-ASH | 5 | 0.038 - 0.105 | 4 | 5 |
| 07-ASH | 5 | 0.0049 - 0.062 | 2 | 5 |
| 01-ASH | 5 | 0.033 - 0.059 | 2 | 5 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **50** |

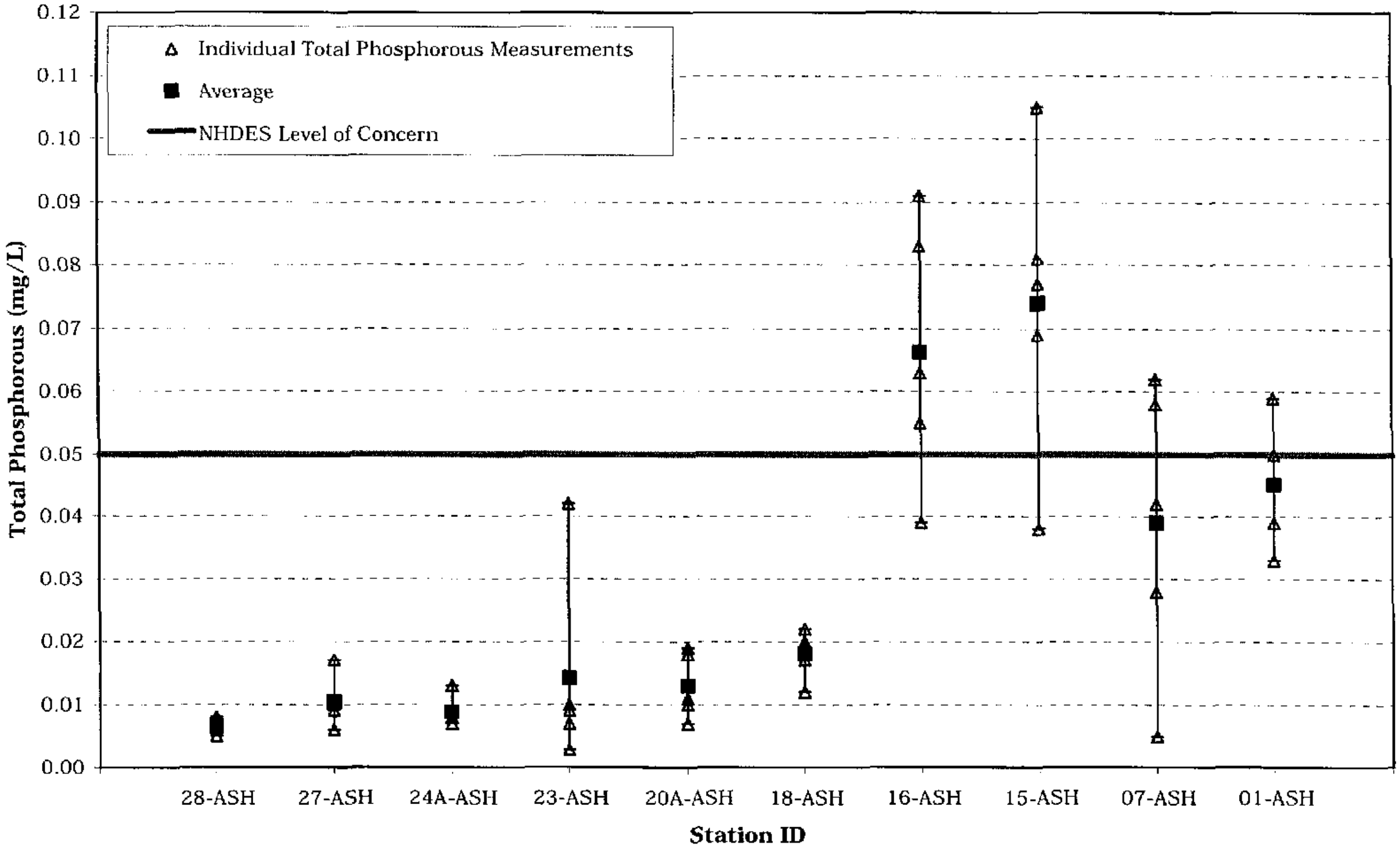
Total phosphorous levels were variable but in general levels increased from upstream stations to downstream stations. All measurements upstream of 16-ASH were below NHDES's level of concern. Total phosphorous levels at 16-ASH and the three stations further downstream had measurements that exceeded NHDES's level of concern. [Figure 5-6]. Under undisturbed natural conditions phosphorous is at very low levels in aquatic ecosystems. Of the three nutrients critical for aquatic plant growth; potassium, nitrogen, and phosphorous, it is usually phosphorous that is the limiting factor to plant growth. When the supply of phosphorous is increased due to human activity algae respond with significant growth.

A major source of excessive phosphorous concentrations in aquatic ecosystems can be wastewater treatment facilities, as sewage typically contains relatively high levels of phosphorus detergents. However, fertilizers used on lawns and agricultural areas can also contribute significant amounts of phosphorus

### 5.6.2. Recommendations

- At stations with elevated total phosphorous levels, begin sampling for chlorophyll-a. As mentioned above, high concentrations of phosphorous will lead to an increase in algal growth. Because algae is a plant and contains chlorophyll-a the concentration of Chlorophyll-a found in the water will give an estimation of the concentration of algae. NHDES uses chlorophyll-a as an indicator in the assessment of surface water for primary contact recreation.
- Continue sampling total phosphorous at all stations as this will help to build a long-term data set to better understand trends as time goes on.

**Figure 5-6. Total Phosphorous Statistics for the Ashuelot River, New Hampshire, May 22 - September 18, 2004, NHDES VRAP**



# APPENDIX
# 2004 ASHUELOT RIVER WATER QUALITY DATA

# 2004 ASHUELOT RIVER VRAP DATA

| | |
|---|---|
| (shaded) | Measurements not meeting New Hampshire surface water quality standards |
| (blank) | Total Phosphorous measurements exceeding NHDES level of concern |
| (diagonal line) | Measurements not meeting NHDES quality assurance/quality control standards |

*Abbreviated standards for quick reference. See Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

## 28-ASH, Route 31, Washington, NH

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Standard*** | **NA** | **>5.0** | **>75% Daily Average** | **NA** | **NA** | **6.5-8.0** | **<10 NTU above backgrd** | **NA** | **<406** | **<126** | **NA** |
| 5/22/2004 | 7:50 | 7.49 | 76.0 | 15.0 | 9.9 | 5.85 | 0.7 | 29.1 | 2 | | 0.005 |
| 6/19/2004 | 7:44 | 7.36 | 83.5 | 21.6 | 19.3 | 5.84 | 0.5 | 28.3 | 6 | | 0.007 |
| 7/17/2004 | 7:56 | 7.46 | 80.9 | 19.6 | 17.8 | 5.99 | 0.4 | 29.0 | 2 | 3 | 0.007 |
| 8/21/2004 | 8:15 | 6.87 | 78.8 | 21.7 | 20.4 | 6.05 | 0.5 | 26.0 | 40 | | 0.006 |
| 9/18/2004 | 8:05 | 8.04 | 84.8 | 18.1 | 14.6 | 6.14 | 0.6 | 24.1 | 20 | | 0.008 |

## 27-ASH, Mountain Road, Lempster, NH

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Standard*** | NA | >5.0 | >75% Daily Average | NA | NA | 6.5-8.0 | <10 NTU above backgrd | NA | <406 | <126 | NA |
| 05/22/2004 | 9:02 | 8.22 | 81.4 | 15 | 9.3 | 5.68 | 0.3 | 32.6 | 7 | | 0.006 |
| 06/19/2004 | 8:40 | 7.64 | 85.6 | 21 | 20.5 | 5.90 | 0.4 | 34.6 | 8 | | 0.010 |
| 07/17/2004 | 8:32 | 7.71 | 83.7 | 19.4 | 20.3 | 5.94 | 0.2 | 36.0 | 7 | 7 | 0.010 |
| 08/21/2004 | 8:45 | 7.03 | 78.1 | 20.7 | 20.3 | 5.75 | 0.5 | 40.5 | 20 | | 0.009 |
| 09/18/2004 | 8:40 | 8.37 | 85.1 | 16.1 | 14.4 | 5.94 | 3.6 | 46.9 | 1460 | | 0.017 |

## 24A-ASH, Route 10, Marlow, NH

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Standard*** | NA | >5.0 | >75% Daily Average | NA | NA | 6.5-8.0 | <10 NTU above backgrd | NA | <406 | <126 | NA |
| 05/22/2004 | 9:45 | 8.16 | 85.7 | 17.7 | 11.1 | 6.57 | 0.1 | 48.8 | 10 | | 0.007 |
| 06/19/2004 | 9:30 | 7.75 | 91.1 | 23.4 | 20.5 | 6.17 | 0.6 | 40.2 | 8 | | 0.008 |
| 07/17/2004 | 9:30 | 7.55 | 85.3 | 21.8 | 22.3 | 6.08 | 0.3 | 47.5 | 10 | 9 | 0.008 |
| 08/21/2004 | 9:30 | 7.38 | 84.1 | 21.9 | 20.7 | 5.79 | 0.2 | 33.4 | 230 | | 0.008 |
| 09/18/2004 | 9:25 | 7.60 | 84.0 | 17.1 | 14.2 | 6.21 | 0.6 | 35.6 | 115 | | 0.013 |

## 23-ASH, Route 10, Gilsum, NH

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | >5.0 | >75% Daily Average | NA | NA | 6.5-8.0 | <10 NTU above backgrd | NA | <406 | <126 | NA |
| 05/22/2004 | 10:17 | 9.22 | 91.1 | 14.8 | 11.5 | 6.41 | 0.1 | 48.8 | 14 | | 0.007 |
| 06/19/2004 | 10:15 | 8.72 | 96.6 | 20.2 | 21.0 | 6.41 | 0.8 | 54.5 | 10 | | 0.009 |
| 07/17/2004 | 10:00 | 8.58 | 93.0 | 19.2 | 21.1 | 6.34 | 0.1 | 59.3 | 8 | 10 | 0.010 |
| 08/21/2004 | 9:58 | 7.87 | 87.3 | 20.6 | 20.8 | 6.22 | 3.7 | 47.3 | 1250 | | 0.003 |
| 08/30/2004 | | | | | | | | | 16 | 54 | |
| 09/18/2004 | 9:55 | 8.90 | 90.1 | 15.6 | 15.1 | 6.21 | 6.8 | 36.9 | 740 | 246 | 0.042 |

## 20A-ASH, Stone Arch Bridge, Keene, NH

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | >5.0 | >75% Daily Average | NA | NA | 6.5-8.0 | <10 NTU above backgrd | NA | <406 | <126 | NA |
| 05/22/2004 | 8:00 | 7.72 | 79.9 | 17.6 | 15.2 | 6.36 | 1.4 | 58.4 | 30 | | 0.007 |
| 06/19/2004 | 8:07 | 7.47 | 83.0 | 20.8 | 20.8 | 6.37 | 0.8 | 67.0 | 48 | | 0.011 |
| 07/17/2004 | 8:00 | 7.39 | 82.7 | 20.3 | 19.9 | 6.53 | 0.6 | 78.5 | 22 | 32 | 0.010 |
| 08/21/2004 | 8:05 | 7.50 | 83.5 | 21.5 | 21.3 | 6.47 | 1.0 | 62.7 | 130 | | 0.019 |
| 09/18/2004 | 8:05 | 8.40 | 86.8 | 17.9 | 15.7 | 6.55 | 3.1 | 55.5 | 350 | | 0.018 |

## 18-ASH, Route 101, Keene, NH

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | >5.0 | >75% Daily Average | NA | NA | 6.5-8.0 | <10 NTU above backgrd | NA | <406 | <126 | NA |
| 05/22/2004 | 9:25 | 7.44 | 80.5 | 17.8 | 14.5 | 6.42 | 1.4 | 91.9 | 106 | | 0.017 |
| 06/19/2004 | 9:14 | 7.36 | 83.2 | 21.1 | 21.6 | 6.40 | 1.0 | 116.1 | 67 | | 0.012 |
| 07/17/2004 | 8:55 | 7.35 | 82.7 | 20.6 | 22.6 | 6.44 | 3.2 | 160.3 | 126 | 96 | 0.019 |
| 08/21/2004 | 8:45 | 7.44 | 84.6 | 21.6 | 20.9 | 6.47 | 1.3 | 81.6 | 370 | | 0.020 |
| 08/30/2004 | | | | | | | | | 116 | 176 | |
| 09/18/2004 | 8:50 | 8.43 | 86.5 | 17.9 | 16.0 | 6.42 | 3.6 | 76.4 | 873 | 335 | 0.022 |

## 16-ASH, Cresson Bridge, Swanzey, NH

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | >5.0 | >75% Daily Average | NA | NA | 6.5-8.0 | <10 NTU above backgrd | NA | <406 | <126 | NA |
| 05/22/2004 | 10:37 | 7.61 | 77.5 | 16.3 | 14.2 | 6.39 | 1.9 | 101.6 | 52 | | 0.039 |
| 06/19/2004 | 9:47 | 7.38 | 83.2 | 19.8 | 20.9 | 6.44 | 1.5 | 125.6 | 120 | | 0.055 |
| 07/17/2004 | 9:30 | 7.43 | 81.3 | 20.1 | 21.4 | 6.55 | 2.4 | 148.5 | 227 | 112 | 0.083 |
| 08/21/2004 | 9:35 | 7.26 | 81.6 | 21.1 | 21.3 | 6.46 | 4.6 | 102.0 | 1840 | | 0.063 |
| 08/30/2004 | | | | | | | | | 190 | 430 | |
| 09/18/2004 | 9:35 | 8.25 | 85.2 | 16.9 | 15.3 | 6.61 | 13.0 | 98.1 | 1840 | 863 | 0.091 |

## 15-ASH, Thompson Bridge, West Swanzey, NH

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | >5.0 | >75% Daily Average | NA | NA | 6.5-8.0 | <10 NTU above backgrd | NA | <406 | <126 | NA |
| 05/22/2004 | 10:06 | 6.30 | 71.0 | 16.5 | 13.1 | 6.49 | 1.4 | 96.9 | 54 | | 0.038 |
| 06/19/2004 | 10:04 | 7.21 | 80.2 | 20.8 | 21.1 | 6.37 | 1.8 | 138.7 | 63 | | 0.081 |
| 07/17/2004 | 10:00 | 6.68 | 73.7 | 21.6 | 23.4 | 6.44 | 1.9 | 138.0 | 50 | 55 | 0.077 |
| 08/21/2004 | 10:10 | 7.02 | 80.2 | 22.1 | 21.8 | 6.31 | 1.6 | 104.5 | 267 | | 0.069 |
| 08/30/2004 | | | | | | | | | 33 | 76 | |
| 09/18/2004 | 9:38 | 7.21 | 77.8 | 18.3 | 16.0 | 6.48 | 4.7 | 108.9 | 1060 | 211 | 0.105 |

## 07-ASH, Route 119, Winchester, NH

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | >5.0 | >75% Daily Average | NA | NA | 6.5-8.0 | <10 NTU above backgrd | NA | <406 | <126 | NA |
| 05/22/2004 | 9:23 | 7.40 | 77.3 | 17.3 | 15.3 | 6.15 | 1.4 | 90.2 | 80 | | 0.028 |
| 06/19/2004 | 9:32 | 7.29 | 81.8 | 21.1 | 21.7 | 6.34 | 1.3 | 124.1 | 126 | | 0.042 |
| 07/17/2004 | 9:20 | 7.40 | 82.4 | 20.8 | 22.1 | 6.56 | 1.5 | 136.1 | 90 | 97 | 0.062 |
| 08/21/2004 | 9:20 | 6.96 | 78.7 | 21.3 | 21.0 | 6.43 | 3.6 | 90.4 | 770 | | 0.0049 |
| 08/30/2004 | | | | | | | | | 30 | 128 | |
| 09/18/2004 | 9:06 | 7.17 | 78.0 | 17.7 | 15.8 | 6.65 | 3.8 | 85.2 | 713 | 254 | 0.058 |

## 01-ASH, 147 River Street, Hinsdale, NH

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Standard*** | **NA** | **>5.0** | **>75% Daily Average** | **NA** | **NA** | **6.5-8.0** | **<10 NTU above backgrd** | **NA** | **<406** | **<126** | **NA** |
| 05/22/2004 | 8:35 | 8.67 | 91.1 | 17.4 | 15.2 | 6.86 | 1.3 | 91.0 | 66 | | 0.033 |
| 06/19/2004 | 8:25 | 7.95 | 89.0 | 20.9 | 21.1 | 6.55 | 1.0 | 125.1 | 57 | | 0.039 |
| 07/17/2004 | 8:27 | 8.65 | 97.0 | 20.9 | 20.9 | 6.75 | 1.3 | 133.9 | 60 | 61 | 0.059 |
| 08/21/2004 | 8:42 | 8.20 | 95.0 | 21.6 | 21.6 | 6.53 | 2.0 | 90.7 | 1790 | | 0.045 |
| 08/30/2004 | | | | | | | | | 60 | 186 | |
| 09/18/2004 | 8:12 | 8.36 | 89.0 | 17.9 | 14.9 | 6.75 | 3.0 | 93.8 | 2020 | 601 | 0.05 |

# New Hampshire Volunteer River Assessment Program
# 2005 Ashuelot River Water Quality Report

*Photo: Ashuelot River (02-ASH), Route 63 Bridge, Hinsdale*


Prepared by:

State of New Hampshire
Department of Environmental Services
Water Division
Watershed Management Bureau



January 2006


NEW HAMPSHIRE DEPARTMENT OF Environmental Services

NHDES- WD-06-02

# New Hampshire Volunteer River Assessment Program
# 2005 Ashuelot River Water Quality Report

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January 2006

Printed on Recycled Paper

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## ACKNOWLEDGEMENTS

The New Hampshire Department of Environmental Services (NHDES) -Volunteer River Assessment Program (VRAP) extends sincere thanks to the volunteers of the Ashuelot River Local Advisory Committee for their efforts during 2005. This report was created solely from the data collected by the volunteers listed below. Their time and dedication is an expression of their genuine concern for local water resources and has significantly contributed to our knowledge of river and stream water quality in New Hampshire.

**2005 Ashuelot River Volunteers**

Jim Beatty

Ken Cole

Pat Eggleston

Penny Eggleston

Geoff Gardner

Carol Glabach

Jim Holley

Bob Lamoy

Carolyn MacDonald

Malcolm MacDonald

Linda McCracken

David Moon

John Parsons

Steve Poole

Barbara Richter

Barbara Skuly

Jay Smeltz

Steve Steppenuck

Ann Sweet

Roger Sweet

Bob Thompson

# 1. INTRODUCTION

## 1.1. Purpose of Report

Each year the VRAP prepares and distributes a water quality report for each volunteer group that is based solely on the water quality data collected by that volunteer group during a specific year. The reports summarize and interpret the data, particularly as they relate to New Hampshire surface water quality standards, and serve as a teaching tool and guidance document for future monitoring activities by the individual volunteer groups.

## 1.2. Report Format

Each report includes the following:

- **Volunteer River Assessment Program (VRAP) Overview**

  This section includes a discussion of the history of VRAP, the technical support, training and guidance provided by NHDES, and how data is transmitted to the volunteers and used in surface water quality assessments.

- **Monitoring Program Description**

  This section provides a description of the volunteer group's monitoring program including monitoring objectives as well as a table and map showing sample station locations.

- **Results and Discussion**

  Water quality data collected during the year are summarized on a parameter-by-parameter basis using (1) a summary table that includes the number of samples collected, data ranges, the number of samples meeting New Hampshire water quality standards, and the number of samples adequate for water quality assessments at each station, (2) a discussion of the data, (3) a list of applicable recommendations, and (4) a river graph showing the range of measured values at each station. Sample results reported as less than the detection limit were assumed equal to one-half the detection limit on the river graphs. This approach simplifies the understanding of the parameter of interest, and specifically helps one to visualize how the river or watershed is functioning from upstream to downstream. In addition, this format allows the reader to better understand potential pollution areas and target those areas for additional sampling or environmental enhancements. Where applicable, the river graph also shows New Hampshire surface water quality standards or levels of concern for comparison purposes.

- **Appendix A – Data**

  This appendix includes a spreadsheet showing the data results and additional information, such data results which do not meet New Hampshire surface water quality standards, and data that is unusable for assessment purposes due to quality control requirements.

- **Appendix B – Interpreting VRAP Water Quality Parameters**

  This appendix includes a brief description of water quality parameters typically sampled by VRAP volunteers and their importance, as well as applicable state water quality criteria or levels of concern.

- **Appendix C – Glossary of River Ecology Terms**

  This appendix contains a list of terms commonly used when discussing river ecology and water quality.

# 2. PROGRAM OVERVIEW

## 2.1. Past, Present, and Future

In 1998, the New Hampshire Department of Environmental Services (NHDES) initiated the New Hampshire Volunteer River Assessment Program (VRAP) as a means of expanding public education of water resources in New Hampshire. VRAP promotes awareness and education of the importance of maintaining water quality in rivers and streams. VRAP was created in the wake of the success of the existing New Hampshire Volunteer Lake Assessment Program (VLAP), which provides educational and stewardship opportunities pertaining to lakes and ponds to New Hampshire's residents.

Today, VRAP continues to serve the public by providing water quality monitoring equipment, technical support, and educational programs. In 2005, VRAP supported twenty-eight volunteer groups on numerous rivers and watersheds throughout the state. These volunteer groups conduct water quality monitoring on an ongoing basis. The work of the VRAP volunteers increases the amount of river water quality information available to local, state and federal governments, which allows for effective financial resource allocation and watershed planning.

## 2.2. Technical Support

VRAP lends and maintains water quality monitoring kits for volunteer groups throughout the state. The kits contain electronic meters and supplies for "in-the-field" measurements of water temperature, dissolved oxygen, pH, specific conductance (conductivity), and turbidity. These are the core parameters typically measured by volunteers. However, other water quality parameters such as nutrients, metals, and *E. coli* can also be studied by volunteer groups, although VRAP does not always provide funds to cover laboratory analysis costs. Thus, VRAP encourages volunteer groups to pursue other fundraising activities such as association membership fees, special events, in-kind services (non-monetary contributions from individuals and organizations), and grant writing.

VRAP typically recommends sampling every other week during the summer, and volunteer groups are encouraged to organize a long-term sampling program in order to begin to determine trends in river conditions. Each year volunteers design and arrange a sampling schedule in cooperation with NHDES staff. Project designs are created through a review and discussion of existing water quality information, such as known and perceived problem areas or locations of exceptional water quality. The interests, priorities, and resources of the partnership determine monitoring locations, parameters, and frequency.

Water quality measurements repeated over time create a picture of the fluctuating conditions in rivers and streams and help to determine where improvements, restoration or preservation may benefit the river and the communities it supports. Water quality results are also used to determine if a river is meeting surface water quality standards. Volunteer monitoring results, meeting DES Quality Assurance and Quality Control (QA/QC) requirements, supplement the efforts of DES to assess the condition of New Hampshire surface waters. The New Hampshire Surface Water Quality Regulations are available through the DES Public Information Center at www.des.state.nh.us/wmb/Env-Ws1700.pdf or (603) 271-1975.

## 2.3. Training and Guidance

Each VRAP volunteer attends an annual training session to receive a demonstration of monitoring protocols and sampling techniques. Training sessions are an opportunity for volunteers to receive an updated version of monitoring techniques. During the training, volunteers have an opportunity for hand-on use of the VRAP equipment and may also receive instruction in the collection of samples for laboratory analysis. Training is accomplished in approximately two hours, after which volunteers are certified in the care, calibration, and use of the VRAP equipment. In some cases, veteran group coordinators can attend a "train the trainer" session. In these trainings the group coordinator receives an update in sampling protocols and techniques and will then train the individual volunteers of their respective group.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. NHDES staff from the VRAP program aim to visit each group annually during a scheduled sampling events to verify that volunteers successfully follow the VRAP protocols. If necessary, volunteers are re-trained during the visit, and the group's monitoring coordinator is notified of the result of the verification visit. VRAP groups forward water quality results to NHDES for incorporation into an annual report and state water quality assessment activities.

## 2.4. Data Usage

### 2.4.1. Annual Water Quality Reports

All data collected by volunteers are summarized in water quality reports that are prepared and distributed after the conclusion of the sampling period (typically fall or winter). Each volunteer group receives copies of the report. The volunteers can use the reports and data as a means of understanding the details of water quality, guiding future sampling efforts, or determining restoration activities.

### 2.4.2. New Hampshire Surface Water Quality Assessments

Along with data collected from other water quality programs, specifically the State Ambient River Monitoring Program, applicable volunteer data are used to support periodic DES surface water quality assessments. VRAP data are entered into NHDES's Environmental Monitoring Database and are ultimately uploaded to the Environmental Protection Agency's database, STORET.

Assessment results and the methodology used to assess surface waters are published by DES every two years (i.e., Section 305(b) Water Quality Reports) as required by the federal Clean Water Act. The reader is encouraged to log on to the DES web page to review the assessment methodology and list of impaired waters http://www.des.state.nh.us/wmb/swqa/.

## 2.5. Quality Assurance/Quality Control

In order for VRAP data to be used in the assessment of New Hampshire's surface waters, the data must meet quality control guidelines as outlined in the VRAP Quality Assurance Project Plan (QAPP). The VRAP QAPP was approved by NHDES and reviewed by EPA in the summer of 2003. The QAPP is reviewed annually and is officially updated and approved every five years. The VRAP Quality Assurance/Quality Control (QA/QC) measures include a six-step approach to ensuring the accuracy of the equipment and consistency in sampling efforts.

- **Calibration**: Prior to each measurement, the pH and dissolved oxygen meters are calibrated. Conductivity and turbidity meters are calibrated and/or checked against a known standard before the first measurement and after the last one.

- **Replicate Analysis**: A second measurement by each meter is taken from the original sample at one of the stations during the sampling day. The replicate analysis should not be conducted at the same station over and over again, but should be conducted at different stations throughout the monitoring season.

- **6.0 pH Standard**: A reading of the pH 6.0 buffer is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the 6.0 pH standard check should be conducted at different stations.

- **Zero Oxygen Standard**: A reading of a zero oxygen solution is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the zero oxygen standard check should be conducted at different stations.

- **DI Turbidity Blank**: A reading of the DI blank is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the blank check should be conducted at different stations.

- **Post-Calibration**: At the conclusion of each sampling day, all meters are calibrated.

### 2.5.1. Measurement Performance Criteria

Precision is calculated for field and laboratory measurements through measurement replicates (instrumental variability) and is calculated for each sampling day. The use of VRAP data for assessment purposes is contingent on compliance with a parameter-specific relative percent difference (RPD) as derived from equation 1, below. Any data exceeding the limits of the individual measures are disqualified from surface water quality assessments. All data that exceeds the limits defined by the VRAP QAPP are acknowledged in the data tables with an explanation of why the data was unusable. Table 1 shows typical parameters studied under VRAP and the associated quality control procedures.

(Equation 1)

$$RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100 \ \%$$

where $x_1$ is the original sample and $x_2$ is the replicate sample

**Table 1. Field Analytical Quality Controls**

| Water Quality Parameter | QC Check | QC Acceptance Limit | Corrective Action | Person Responsible for Corrective Action | Data Quality Indicator |
|---|---|---|---|---|---|
| Temperature | Measurement replicate | ± 0.2 °C | Repeat measurement | Volunteer Monitors | Precision |
| Dissolved Oxygen | Measurement replicate | ± 2% of saturation, or ± 0.2 mg/L | Recalibrate instrument, repeat measurement | Volunteer Monitors | Precision |
| | Known buffer (zero $O_2$ solution) | <0.5 mg/L | Recalibrate instrument, repeat measurement | Volunteer Monitors | Relative accuracy |
| pH | Measurement replicate | ± 0.1 std units | Recalibrate instrument, repeat measurement | Volunteer Monitors | Precision |
| | Known buffer (pH = 6.0) | ± 0.1 standard units | Recalibrate instrument repeat measurement | Volunteer Monitors | Accuracy |
| Specific Conductance | Measurement replicate | ± 30 µS/cm | Recalibrate instrument, repeat measurement | Volunteer Monitors | Precision |
| | Method blank (Zero air reading) | ± 5.0 µS/cm | Recalibrate instrument, repeat measurement | Volunteer Monitors | Accuracy |
| Turbidity | Measurement replicate | ± 0.1 NTU | Recalibrate instrument, repeat measurement | Volunteer Monitors | Precision |
| | Method blank (DI Water) | ± 0.1 NTU | Recalibrate instrument, repeat measurement | Volunteer Monitors | Accuracy |

## 3. METHODS

Volunteers from the Ashuelot River Local Advisory Committee have been monitoring water quality on the Ashuelot River since 2001. The goal of this effort was to provide water quality data from the Ashuelot River relative to surface water quality standards and to allow for the assessment of the river for support of aquatic life and primary contact recreation. The establishment of a long-term monitoring program allows for an understanding of the river's dynamics, or variations on a station-by-station and year-to-year basis. The data can also serve as a baseline from which to determine any water pollution problems in the river and/or watershed. The Volunteer River Assessment Program has provided field training, equipment, financial assistance, and technical assistance.

During 2005, trained volunteers from the Ashuelot River Local Advisory Committee monitored water quality at ten sites along the mainstem of the Ashuelot River from its upper limits in Washington to just upstream of its confluence with the Connecticut River in Hinsdale (Figure 1, Table 2). Stations ID's are designated using a three letter code to identify the waterbody name plus a number indicating the relative position of the station. The higher the station number the more upstream the station is in the watershed. All stations monitored in 2005 are designated as Class B waters.

Water quality monitoring was conducted monthly from May to September. In-situ measurements of water temperature, air temperature, dissolved oxygen, pH, and specific conductance were taken using handheld meters provided by NHDES. Turbidity samples were collected in the field, brought to a central location and measured the same day using a handheld meter. Samples for *E.coli* and total phosphorous were taken using sterile and/or preserved bottles and were stored on ice during transport from the field to the lab. Table 3 summarizes the parameters measured, laboratory standard methods, and equipment used.

**Table 2. Sampling Stations for the Ashuelot River, NHDES VRAP, 2005**

| Station ID | Location | Town | Elevation* |
|---|---|---|---|
| 28-ASH | Route 31 | Washington | 1600 |
| 27-ASH | Mountain Road | Lempster | 1500 |
| 24A-ASH | Route 10 | Marlow | 1100 |
| 23-ASH | Route 10 | Gilsum | 800 |
| 20A-ASH | Stone Arch Bridge | Keene | 500 |
| 18-ASH | Route 101 | Keene | 500 |
| 16-ASH | Cresson Bridge | Swanzey | 500 |
| 15-ASH | Thompson Bridge | West Swanzey | 400 |
| 07-ASH | Route 119 | Winchester | 400 |
| 01-ASH | 147 River Street | Hinsdale | 200 |

*Elevations have been rounded off to 100-foot increments for calibration of dissolved oxygen meter

**Figure 1. Ashuelot River Watershed and Monitoring Stations 2005**

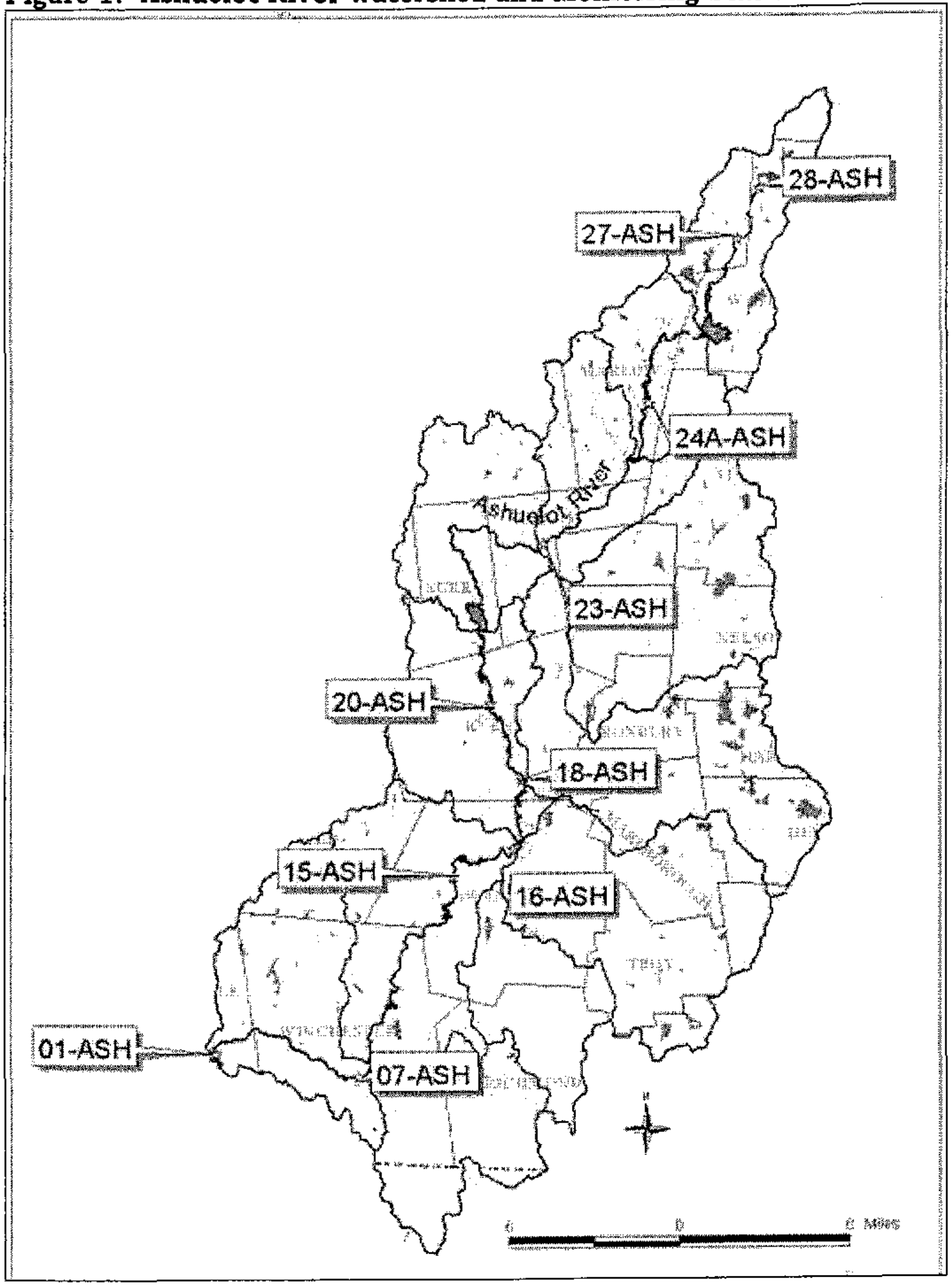


**Table 3. Sampling and Analysis Methods**

| Parameter | Sample Type | Standard Method | Equipment Used | Laboratory |
|---|---|---|---|---|
| Temperature | In-Situ | SM 2550 | YSI 95 | ------ |
| Dissolved Oxygen | In-Situ | SM 4500 O G | YSI 95 | ------ |
| pH | In-Situ | SM 4500 H+ | Orion 210A+ | ------ |
| Turbidity | Bottle (Same Day) | EPA 180.1 | YSI 30 | ------ |
| Specific Conductance | In-Situ | SM 2510 | Lamotte 2020 | ------ |
| E.coli | Bottle (Sterile) | SM 19 9213 D.3 | ------ | NHDES |
| | Bottle (Sterile) | EPA 1103.1 | ------ | Keene WWTF |
| Total Phosphorous | Bottle (w/Preservative) | EPA 365.3 | ------ | NHDES |

# 4. RESULTS AND DISCUSSION

## 4.1. Dissolved Oxygen

Five measurements were taken in the field for dissolved oxygen concentration at ten stations on the mainstem of the Ashuelot River from Washington to Hinsdale. (Table 4). Of the 50 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

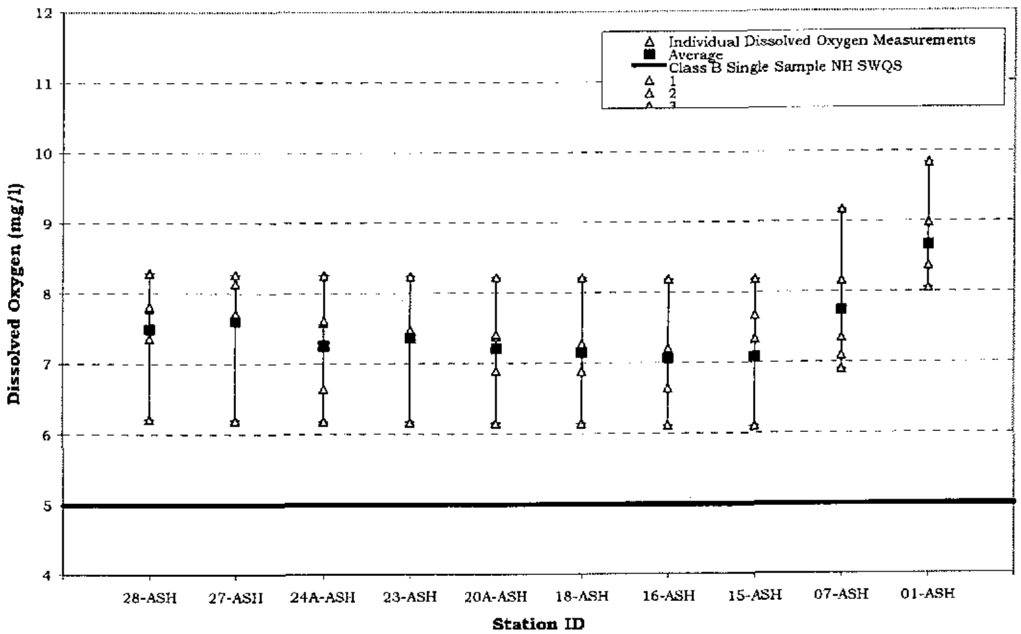
The Class B New Hampshire surface water quality standard for dissolved oxygen includes a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be assessed as meeting dissolved oxygen standards. Table 4 reports only dissolved oxygen concentration as more detailed analysis is required to determine if instantaneous dissolved oxygen saturation measurements are above or below water quality standards.

**Table 4. Dissolved Oxygen Concentration Data Summary -Ashuelot River, 2005**

| Station ID | Samples Collected | Data Range (mg/l) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 5 | 81.2 - 87.2 | 0 | 5 |
| 27-ASH | 5 | 79.2 - 89.9 | 0 | 5 |
| 24A-ASH | 5 | 83.3 - 92.6 | 0 | 5 |
| 23-ASH | 5 | 80.3 - 99.2 | 0 | 5 |
| 20A-ASH | 5 | 74.4 - 86.9 | 0 | 5 |
| 18-ASH | 5 | 74.2 - 88.1 | 0 | 5 |
| 16-ASH | 5 | 73.0 - 85.8 | 0 | 5 |
| 15-ASH | 5 | 67.1 - 87.1 | 0 | 5 |
| 07-ASH | 5 | 78.2 - 89.3 | 0 | 5 |
| 01-ASH | 5 | 90.1 - 96.4 | 0 | 5 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **50** |

Dissolved oxygen concentration levels were above state standards on all occasions and at all stations (Figure 2). The average concentration of dissolved oxygen was consistently above the Class B standard at all stations ranging from 7.1 mg/L to 8.7 mg/L. Levels of dissolved oxygen sustained above the standards are considered adequate for the support of aquatic life and other desirable water quality conditions.

**Figure 2. Dissolved Oxygen Statistics for the Ashuelot River, New Hampshire, July 23, 2005 - September 17, 2005, NHDES VRAP**




## Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.
- If possible, take measurements between 5:00 a.m. and 10:00 a.m., which is when dissolved oxygen is usually the lowest, and between 2:00 p.m. and 7:00 p.m. when dissolved oxygen is usually the highest. In general, dissolved oxygen levels are lowest in the early morning when there is low photosynthetic activity and a peak in respiration from organisms throughout the water column. This is the time of least oxygen production and greatest carbon dioxide emission. Peak dissolved oxygen levels occur when photosynthetic activity is at its peak. The greater the amount of photosynthetic activity the greater the production of oxygen as a byproduct of photosynthesis.
- Next year incorporate the use of in-situ dataloggers to automatically record dissolved oxygen saturation levels during a period of several days. This will allow for the calculation of the daily average for dissolved oxygen per cent saturation. Dataloggers can be put in the water for a period of several days and collect data at specific time intervals (e.g. every 15 minutes). The use of these instruments is dependent upon availability, and requires coordination with NHDES.

## 4.2. pH

Five measurements were taken in the field for pH at ten stations on the mainstem of the Ashuelot River from Washington to Hinsdale [Table 5]. Of the 50 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency. The Class B New Hampshire surface water quality standard is 6.5 - 8.0, unless naturally occurring.

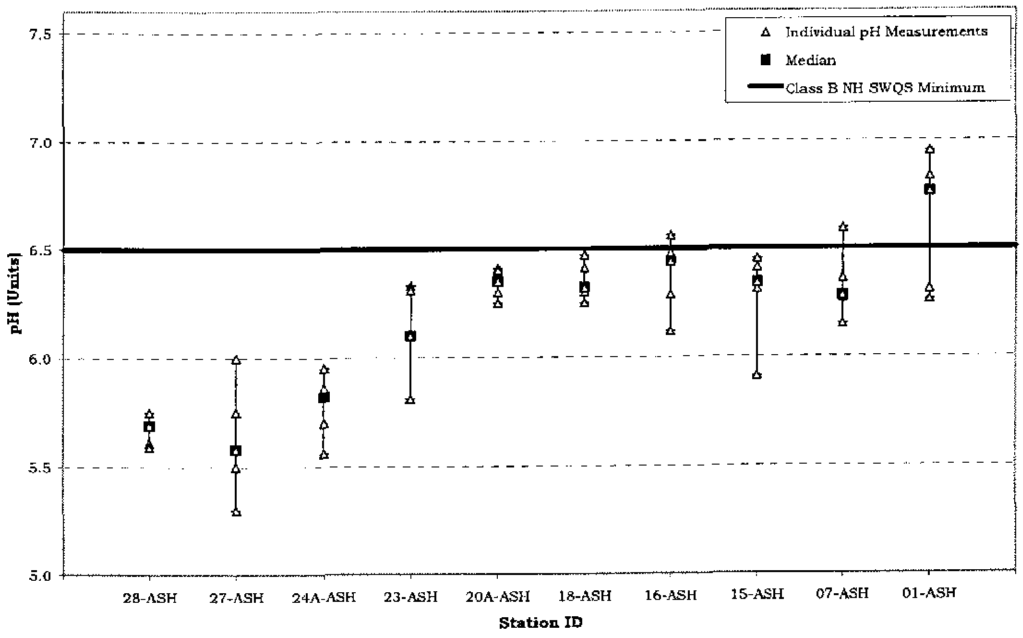
**Table 5. pH Data Summary - Ashuelot River, 2005**

| Station ID | Samples Collected | Data Range (standard units) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 5 | 5.59 - 5.75 | 5 | 5 |
| 27-ASH | 5 | 5.3 - 6.0 | 5 | 5 |
| 24A-ASH | 5 | 5.56 - 5.95 | 5 | 5 |
| 23-ASH | 5 | 5.81 - 6.33 | 5 | 5 |
| 20A-ASH | 5 | 6.25 - 6.41 | 5 | 5 |
| 18-ASH | 5 | 6.25 - 6.47 | 5 | 5 |
| 16-ASH | 5 | 6.12 - 6.56 | 4 | 5 |
| 15-ASH | 5 | 5.91 - 6.45 | 5 | 5 |
| 07-ASH | 5 | 6.15 - 6.59 | 4 | 5 |
| 01-ASH | 5 | 6.26 - 6.95 | 2 | 5 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **50** |

All stations, with the exception of 01-ASH, had a majority of the pH measurements below the New Hampshire surface water quality standard (Figure 3).

Lower pH measurements are likely the result of natural conditions such as the soils, geology, or the presence of wetlands in the area. Rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels; after the spring melt or significant rain events, surface waters will generally have a lower pH.

Figure 3. pH Statistics for the Ashuelot River, New Hampshire,
July 23 - September 17, 2005, NHDES VRAP




## Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.

- Consider sampling for pH in some of the tributaries and wetland areas that are influencing the pH of stations with measurements below state standards. Site conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.

## 4.3. Turbidity

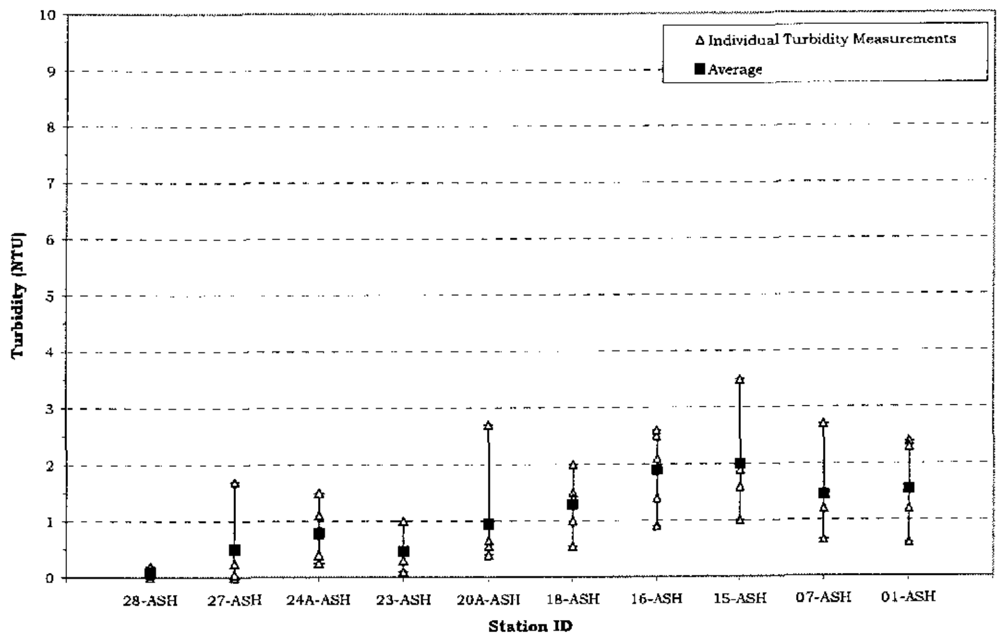
Five measurements were taken in the field for turbidity at ten stations on the mainstem of the Ashuelot River from Washington to Hinsdale [Table 6]. Of the 50 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency. The Class B New Hampshire surface water quality standard for turbidity is less than 10 NTU above background.

**Table 6. Turbidity Data Summary - Ashuelot River, 2005**

| Station ID | Samples Collected | Data Range (NTU) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 5 | 0.0 - 0.2 | 0 | 5 |
| 27-ASH | 5 | 0.0 - 1.7 | 0 | 5 |
| 24A-ASH | 5 | 0.3 - 1.5 | 0 | 5 |
| 23-ASH | 5 | 0.1 - 1.0 | 0 | 5 |
| 20A-ASH | 5 | 0.4 - 2.7 | 0 | 5 |
| 18-ASH | 5 | 0.6 - 2.0 | 0 | 5 |
| 16-ASH | 5 | 0.9 - 2.6 | 0 | 5 |
| 15-ASH | 5 | 1.0 - 3.5 | 0 | 5 |
| 07-ASH | 5 | 0.7 - 2.7 | 0 | 5 |
| 01-ASH | 5 | 0.6 - 2.4 | 0 | 5 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **50** |

Turbidity levels were low on all occasions and at all stations with the average ranging from 0.1 NTU to 2.0 NTU (Figure 4). Although clean waters are associated with low turbidity there is a high degree of natural variability involved. Precipitation often contributes to increased turbidity by flushing sediment, organic matter and other materials from the surrounding landscape into surface waters. However, human activities such as removal of vegetation near surface waters and disruption of nearby soils can lead to dramatic increases in turbidity levels. In general it is typical to see a rise in turbidity in more developed areas due to increased runoff.

**Figure 4. Turbidity Statistics for the Ashuelot River, New Hampshire, July 23, 2005 - September 17, 2005, NHDES VRAP**




## Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.

- Collect samples during wet weather. This will help us to understand how the river responds to runoff and sedimentation.

- If a higher than normal turbidity measurement occurs, volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated turbidity levels. In addition, take good field notes and photographs. If human activity is suspected or verified as the source of elevated turbidity levels volunteers should contact NHDES.

## 4.4. Specific Conductance

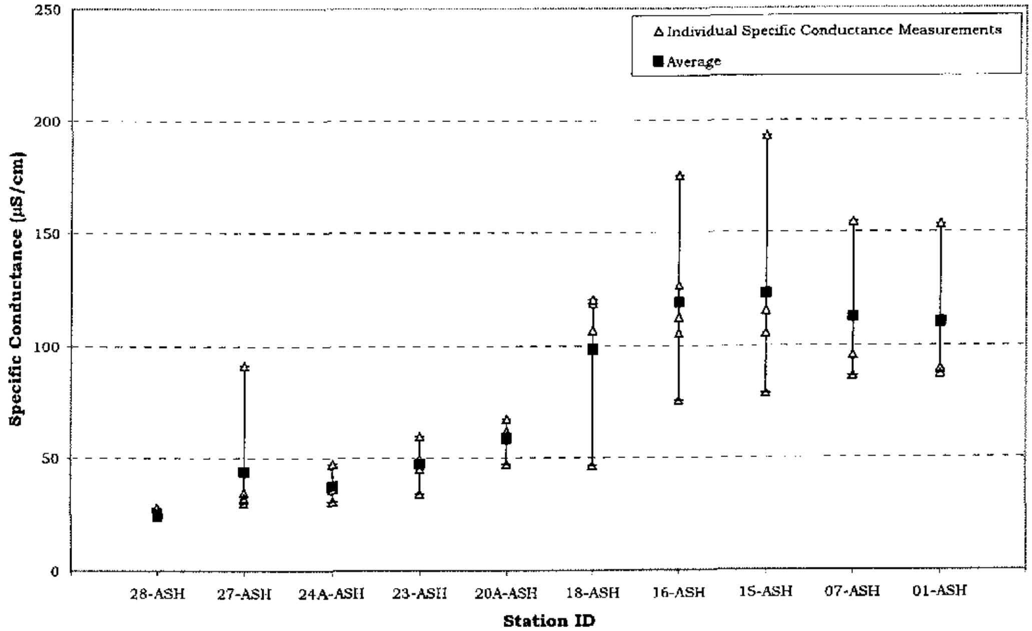
Five measurements were taken in the field for specific conductance at ten stations on the mainstem of the Ashuelot River from Washington to Hinsdale [Table 7]. Of the 50 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency. New Hampshire surface water quality standards do not contain numeric limits for specific conductance.

**Table 7. Specific Conductance Data Summary - Ashuelot River, 2005**

| Station ID | Samples Collected | Data Range (µS/cm) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 5 | 24.1 - 28.0 | Not Applicable | 5 |
| 27-ASH | 5 | 30.2 - 91.3 | N/A | 5 |
| 24A-ASH | 5 | 30.8 - 47.3 | N/A | 5 |
| 23-ASH | 5 | 34.1 - 59.7 | N/A | 5 |
| 20A-ASH | 5 | 47.2 - 67.3 | N/A | 5 |
| 18-ASH | 5 | 46.8 - 120.6 | N/A | 5 |
| 16-ASH | 5 | 75.7 - 175.2 | N/A | 5 |
| 15-ASH | 5 | 78.7 - 192.9 | N/A | 5 |
| 07-ASH | 5 | 86.7 - 154.7 | N/A | 5 |
| 01-ASH | 5 | 87.4 - 153.6 | N/A | 5 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **50** |

Specific conductance levels were variable river with individual readings ranging from 25 µS/cm to 123 µS/cm (Figure 5). Higher specific conductance levels can be indicative of pollution from sources such as urban/agricultural runoff, road salt, failed septic systems, or groundwater pollution. Thus, the variable specific conductance levels in the Ashuelot River watershed indicate low pollutant levels at some stations and potentially higher levels at others.

**Figure 5. Specific Conductance Statistics for the Ashuelot River, New Hampshire, July 23 - September 17, 2005, NHDES VRAP**




## Recommendations

- ❖ Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.

- ❖ Consider collecting chloride samples at the same time specific conductance is measured. During the late winter/early spring snowmelt, higher conductivity levels are often seen due to elevated concentrations of chloride in the runoff. Conductivity levels are very closely correlated to chloride levels. Simultaneously measuring chloride and conductivity will allow for a better understanding of their relationship.

## 4.5. Bacteria/*Escherichia coli*

Five measurements were taken in the field for E. *coli* at ten stations on the mainstem of the Ashuelot River from Washington to Hinsdale [Table 8]. Of the 50 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

Class B NH surface water quality standards for *E.coli* are as follows:

<406 cts/100 ml, based on any single sample, or
<126 cts/100 ml, based on a geometric mean calculated from three samples collected within a 60-day period.

**Table 8. E. *coli* Data Summary – Ashuelot River, 2005**

| Station ID | Samples Collected | Data Range (cts/100ml) | Acceptable Samples Not Meeting NH Class B Standards | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| 28-ASH | 5 | 4 - 30 | 0 | 5 |
| 27-ASH | 5 | 14 - 44 | 0 | 5 |
| 24A-ASH | 5 | 14 - 54 | 0 | 5 |
| 23-ASH | 5 | 10 - 83 | 0 | 5 |
| 20A-ASH | 5 | 4 - 63 | 0 | 5 |
| 18-ASH | 5 | 34 - 164 | 0 | 5 |
| 16-ASH | 5 | 24 - >2000 | 1 | 5 |
| 15-ASH | 5 | 14 - 150 | 0 | 5 |
| 07-ASH | 5 | 32 - 203 | 0 | 5 |
| 01-ASH | 5 | 27 - 900 | 1 | 5 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **50** |

Two stations (16-ASH and 01-ASH) had single sample levels which exceeded the New Hampshire surface water quality standard (Figure 6). All other stations had no occasions where *E.coli* levels were above the standard. In order to fully determine whether a waterbody is meeting surface water standards for *E.coli* a geometric mean must be calculated. A geometric mean is calculated using three samples collected within a 60-day period. At all ten stations a geometric mean was calculated and two of the stations (18-ASH and 16-ASH) had geometric means that violated the surface water quality standard of 126 cts/100ml (Table 9).

Several factors can contribute to elevated *E. coli* levels, including, but not limited to rain storms, low river flows, the presence of wildlife (e.g., birds), and the presence of septic systems along the river.

**Figure 6. *Escherichia coli* Statistics for the Ashuelot River, New Hampshire, July 23 - September 17, 2005, NHDES VRAP**

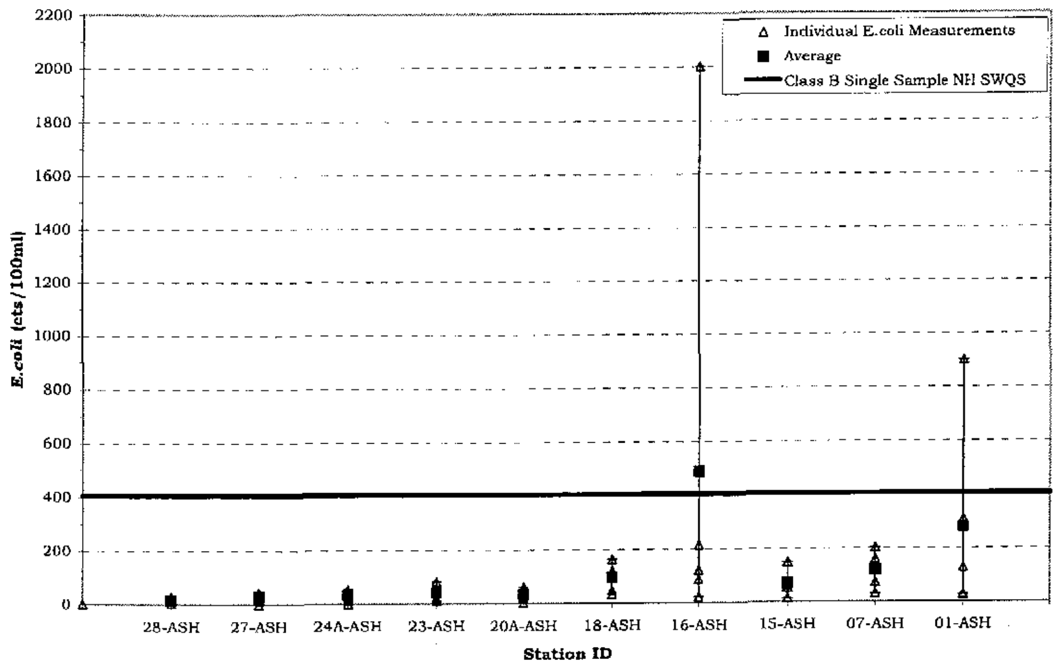



**Table 9. *E. coli* Geometric Mean Data Summary - Ashuelot River, 2005**

| Station ID | Geometric Mean (7/23/05 – 9/17/05 | Geometric Means Not Meeting NH Class B Standards |
|---|---|---|
| **28-ASH** | 12 | 0 |
| **27-ASH** | 23 | 0 |
| **24A-ASH** | 23 | 0 |
| **23-ASH** | 45 | 0 |
| **20A-ASH** | 33 | 0 |
| **18-ASH** | 134 | 1 |
| **16-ASH** | 138 | 1 |
| **15-ASH** | 65 | 0 |
| **07-ASH** | 116 | 0 |
| **01-ASH** | 102 | 0 |

## Recommendations

- Continue collecting three samples within any 60-day period during the summer to allow for determination of geometric means.

- Continue to document river conditions and station characteristics (including the presence of wildlife in the area during sampling).

- At stations with particularly high bacteria levels volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated bacteria levels. Those sampling should also look for any potential sources of bacteria such as emission pipes and failed septic systems.

## 4.6. Total Phosphorus

Five measurements were taken in the field for total phosphorus at ten stations on the mainstem of the Ashuelot River from Washington to Hinsdale [Table 9]. Of the 50 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

There is no numeric standard for total phosphorus for Class B waters. The narrative standard states that "unless naturally occurring, shall contain no phosphorus in such concentrations that would impair any existing or designated uses." The NHDES "level of concern" for total phosphorous is 0.05 mg/L.

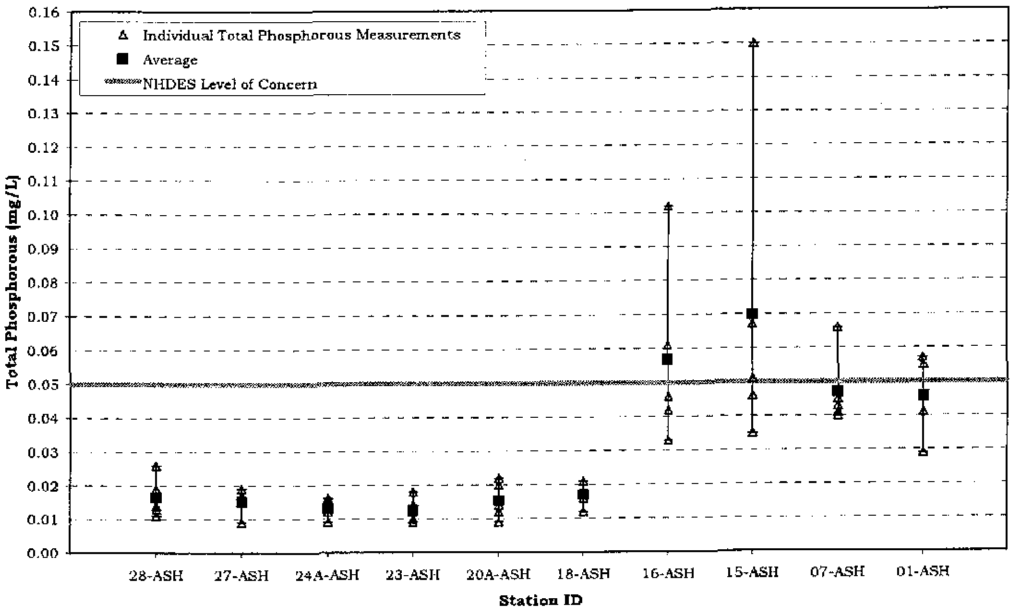
**Table 9. Total Phosphorus Data Summary – Ashuelot River, 2005**

| Station ID | Samples Collected | Data Range (mg/L) | Acceptable Samples Exceeding NHDES Level of Concern | Number of Usable Samples for 2006 NH Surface Water Quality Assessment |
|---|---|---|---|---|
| **28-ASH** | 5 | 0.011 - 0.026 | 0 | 5 |
| **27-ASH** | 5 | 0.009 - 0.019 | 0 | 5 |
| **24A-ASH** | 5 | 0.009 - 0.016 | 0 | 5 |
| **23-ASH** | 5 | 0.009 - 0.018 | 0 | 5 |
| **20A-ASH** | 5 | 0.009 - 0.022 | 0 | 5 |
| **18-ASH** | 5 | 0.012 - 0.021 | 0 | 5 |
| **16-ASH** | 5 | 0.033 - 0.102 | 2 | 5 |
| **15-ASH** | 5 | 0.035 - 0.15 | 3 | 5 |
| **07-ASH** | 5 | 0.04 - 0.066 | 1 | 5 |
| **01-ASH** | 5 | 0.029 - 0.057 | 2 | 5 |
| **Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment** | | | | **50** |

Total phosphorous levels were variable but, in general, levels increased from upstream stations to downstream stations. All measurements upstream of 16-ASH were below NHDES's level of concern. All stations from 16-ASH downstream to 01-ASH had total phosphorous measurements that exceeded NHDES's level of concern. Under undisturbed natural conditions phosphorous is at very low levels in aquatic ecosystems. Of the three nutrients critical for aquatic plant growth; potassium, nitrogen, and phosphorous, it is usually phosphorous that is the limiting factor to plant growth. When the supply of phosphorous is increased due to human activity, algae respond with significant growth.

A major source of excessive phosphorous concentrations in aquatic ecosystems can be wastewater treatment facilities, as sewage typically contains relatively high levels of phosphorus detergents. However, fertilizers used on lawns and agricultural areas can also contribute significant amounts of phosphorus.

Figure 7. Total Phosphorous Statistics for the Ashuelot River, New Hampshire, July 23 - September 17, 2005, NHDES VRAP




## Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.

# APPENDIX A

## 2005 Ashuelot River Watershed Water Quality Data

# APPENDIX B

## Interpreting VRAP Water Quality Parameters

# APPENDIX C

## Glossary of River Ecology Terms

# 2005 ASHUELOT RIVER VRAP DATA

| | |
|---|---|
| (light shading) | Measurements not meeting New Hampshire surface water quality standards |
| (dark shading) | Total Phosphorous measurements exceeding NHDES level of concern |
| (diagonal line) | Measurements not meeting NHDES quality assurance/quality control standards |

*Abbreviated standards for quick reference. See Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

## 28-ASH, Route 31, Washington

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | >5.0 | >75% Daily Average | NA | NA | 6.5-8.0 | <10 NTU above backgrd | NA | <406 | <126 | NA |
| 5/21/05 | 07:50 | 6.21 | 87.2 | 13.0 | 11.3 | 5.75 | 0.0 | 28.0 | 4 | | 0.019 |
| 6/18/05 | 08:14 | 7.78 | 86.7 | 16.5 | 16.0 | 5.69 | 0.2 | 24.6 | 18 | | 0.026 |
| 7/23/05 | 07:47 | 7.82 | 81.2 | 23.1 | 20.8 | 5.59 | 0.1 | 24.8 | 30 | | 0.013 |
| 8/20/05 | 08:10 | 8.29 | 82.1 | 20.4 | 19.5 | 5.69 | 0.2 | 24.6 | 4 | | 0.014 |
| 9/17/05 | 07:55 | 7.36 | 81.2 | 19.9 | 18.8 | 5.61 | 0.1 | 24.1 | 14 | 12 | 0.011 |

## 27-ASH, Mountain Road, Lempster

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard* | NA | >5.0 | >75% Daily Average | NA | NA | 6.5-8.0 | <10 NTU above backgrd | NA | <406 | <126 | NA |
| 5/21/05 | 08:45 | 7.68 | 89.9 | 12.2 | 12.3 | 5.75 | 0.0 | 34.8 | <2 | | 0.015 |
| 6/18/05 | 09:00 | 8.27 | 84.8 | 14.9 | 16.1 | 5.30 | 1.7 | 31.6 | 44 | | 0.019 |
| 7/23/05 | 08:55 | 6.20 | 79.2 | 21.6 | 21.0 | 5.50 | 0.5 | 30.2 | 22 | | 0.016 |
| 8/20/05 | 08:45 | 7.71 | 83.6 | 18.2 | 17.9 | 5.58 | 0.1 | 91.3 | 14 | | 0.009 |
| 9/17/05 | 08:45 | 8.14 | 85.8 | 18.2 | 18.7 | 6.00 | 0.3 | 32.4 | 38 | 23 | 0.017 |

## 24A-ASH, Route 10, Marlow

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Standard*** | **NA** | **>5.0** | **>75% Daily Average** | **NA** | **NA** | **6.5-8.0** | **<10 NTU above backgrd** | **NA** | **<406** | **<126** | **NA** |
| 5/21/05 | 09:30 | 8.25 | 92.6 | 14.6 | 13.7 | 5.82 | 0.4 | 37.0 | <2 | | 0.016 |
| 6/18/05 | 09:30 | 6.18 | 88.6 | 16.8 | 16.2 | 5.56 | 1.5 | 30.8 | 54 | | 0.015 |
| 7/23/05 | 09:30 | 7.58 | 85.1 | 24.3 | 21.9 | 5.70 | 0.8 | 36.7 | 20 | | 0.014 |
| 8/20/05 | 09:30 | 7.61 | 84.1 | 21.3 | | 5.86 | 1.1 | 47.3 | 14 | | 0.012 |
| 9/17/05 | 09:40 | 6.64 | 83.3 | 20.5 | 19.8 | 5.95 | 0.3 | 36.1 | 42 | 23 | 0.009 |

## 23-ASH, Route 10, Gilsum

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Standard*** | **NA** | **>5.0** | **>75% Daily Average** | **NA** | **NA** | **6.5-8.0** | **<10 NTU above backgrd** | **NA** | **<406** | **<126** | **NA** |
| 5/21/05 | 10:05 | 7.44 | 99.2 | 13.0 | 12.7 | 6.33 | 0.1 | 48.2 | 10 | | 0.012 |
| 6/18/05 | 10:03 | 7.48 | 93.0 | 16.7 | 16.9 | 5.81 | 1.0 | 34.1 | 46 | | 0.014 |
| 7/23/05 | 10:10 | 8.24 | 86.1 | 21.6 | 22.6 | 6.31 | 0.5 | 45.4 | 22 | | 0.018 |
| 8/20/05 | 10:00 | 6.17 | 84.7 | 18.8 | 18.7 | 6.10 | 0.3 | 59.7 | 50 | | 0.010 |
| 9/17/05 | 10:25 | 7.47 | 80.3 | 19.7 | 20.1 | 6.10 | 0.5 | 49.7 | 83 | 45 | 0.009 |

## 20A-ASH, Stone Arch Bridge, Keene

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Standard*** | **NA** | **>5.0** | **>75% Daily Average** | **NA** | **NA** | **6.5-8.0** | **<10 NTU above backgrd** | **NA** | **<406** | **<126** | **NA** |
| 5/21/05 | 07:50 | 8.22 | 82.5 | 13.9 | 12.0 | 6.25 | 0.4 | 62.1 | 4 | | 0.020 |
| 6/18/05 | 08:25 | 6.15 | 86.9 | 17.7 | 16.7 | 6.30 | 2.7 | 47.2 | 60 | | 0.022 |
| 7/23/05 | 08:40 | 7.37 | 74.4 | 23.5 | 20.3 | 6.35 | 0.4 | 58.3 | 22 | | 0.014 |
| 8/20/05 | 08:45 | 7.41 | 76.4 | 21.0 | 19.8 | 6.41 | 0.6 | 67.3 | 25 | | 0.009 |
| 9/17/05 | 08:45 | 6.89 | 77.4 | 20.9 | 20.1 | 6.40 | 0.7 | 59.9 | 63 | 33 | 0.012 |

## 18-ASH, Route 101, Keene

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Standard*** | **NA** | **>5.0** | **>75% Daily Average** | **NA** | **NA** | **6.5-8.0** | **<10 NTU above backgrd** | **NA** | **<406** | **<126** | **NA** |
| 5/21/05 | 08:40 | 7.24 | 76.9 | 14.8 | 12.4 | 6.30 | 0.6 | 99.5 | 34 | | 0.021 |
| 6/18/05 | 08:52 | 7.27 | 88.1 | 18.1 | 17.7 | 6.41 | 2.0 | 46.8 | 48 | | 0.016 |
| 7/23/05 | 09:15 | 8.21 | 80.1 | 23.7 | 22.6 | 6.25 | 1.5 | 106.9 | 121 | | 0.018 |
| 8/20/05 | 09:15 | 6.14 | 79.5 | 21.0 | 20.3 | 6.47 | 1.4 | 119.0 | 164 | | 0.012 |
| 9/17/05 | 09:50 | 6.88 | 74.2 | 20.8 | 20.5 | 6.32 | 1.0 | 120.6 | 122 | 134 | 0.018 |

## 16-ASH, Cresson Bridge, Swanzey

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Standard*** | **NA** | **>5.0** | **>75% Daily Average** | **NA** | **NA** | **6.5-8.0** | **<10 NTU above backgrd** | **NA** | **<406** | **<126** | **NA** |
| 5/21/05 | 09:05 | 8.19 | 83.2 | 13.0 | 12.5 | 6.12 | 0.9 | 112.7 | 24 | | 0.042 |
| 6/18/05 | 09:32 | 6.12 | 85.8 | 17.2 | 17.8 | 6.48 | 2.5 | 75.7 | 124 | | 0.033 |
| 7/23/05 | 10:10 | 7.17 | 78.8 | 22.0 | 21.1 | 6.44 | 2.1 | 105.5 | 217 | | 0.061 |
| 8/20/05 | 10:15 | 7.20 | 78.3 | 19.9 | 19.3 | 6.56 | 1.4 | 126.7 | 88 | | 0.046 |
| 9/17/05 | 10:30 | 6.64 | 73.0 | 19.9 | 19.9 | 6.29 | 2.6 | 175.2 | >2000 | 337 | 0.102 |

## 15-ASH, Thompson Bridge, West Swanzey, NH

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Standard*** | **NA** | **>5.0** | **>75% Daily Average** | **NA** | **NA** | **6.5-8.0** | **<10 NTU above backgrd** | **NA** | **<406** | **<126** | **NA** |
| 5/21/05 | 10:13 | 7.33 | 87.1 | 15.6 | 17.8 | 5.91 | 1.0 | 115.5 | 14 | | 0.051 |
| 6/18/05 | 10:00 | 7.67 | 85.3 | 17.9 | 17.7 | 6.31 | 3.5 | 78.7 | 150 | | 0.035 |
| 7/23/05 | 10:50 | 8.18 | 80.1 | 23.6 | 22.4 | 6.41 | 2.0 | 105.5 | 64 | | 0.067 |
| 8/20/05 | 10:21 | 6.11 | 83.6 | 20.6 | 20.5 | 6.45 | 1.9 | 123.3 | 53 | | 0.046 |
| 9/17/05 | 09:35 | 6.10 | 67.1 | 20.8 | 20.6 | 6.34 | 1.6 | 192.9 | 80 | 65 | 0.150 |

## 07-ASH, Route 119, Winchester, NH

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Standard*** | **NA** | **>5.0** | **>75% Daily Average** | **NA** | **NA** | **6.5-8.0** | **<10 NTU above backgrd** | **NA** | **<406** | **<126** | **NA** |
| 5/21/05 | 09:36 | 9.17 | 89.3 | 14.2 | 13.8 | 6.15 | 0.7 | 112.4 | 32 | | 0.040 |
| 6/18/05 | 09:30 | 8.16 | 86.2 | 17.8 | 17.9 | 6.27 | 2.7 | 86.7 | 203 | | 0.043 |
| 7/23/05 | 10:00 | 6.90 | 81.1 | 23.2 | 25.1 | 6.28 | 1.2 | 95.7 | 133 | | 0.045 |
| 8/20/05 | 09:26 | 7.35 | 82.1 | 20.7 | 20.2 | 6.36 | 1.2 | 113.6 | 73 | | 0.041 |
| 9/17/05 | 08:57 | 7.10 | 78.2 | 20.1 | 20.0 | 6.59 | 1.5 | 154.7 | 160 | 116 | 0.066 |

## 01-ASH, 147 River Street, Hinsdale, NH

| Date | Time of Sample | DO (mg/L) | DO (% sat.) | Water Temp. (°C) | Air Temp. (°C) | pH | Turbidity (NTUs) | Specific Conductance (uS/cm) | *E. coli* (CTS/100mL) | *E.coli* Geometric Mean | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Standard*** | **NA** | **>5.0** | **>75% Daily Average** | **NA** | **NA** | **6.5-8.0** | **<10 NTU above backgrd** | **NA** | **<406** | **<126** | **NA** |
| 5/21/05 | 08:33 | 9.84 | 96.4 | 13.7 | 14.3 | 6.31 | 0.6 | 111.4 | 30 | | 0.055 |
| 6/18/05 | 08:15 | 8.98 | 94.1 | 17.9 | 16.9 | 6.26 | 2.4 | 87.4 | 900 | | 0.046 |
| 7/23/05 | 08:40 | 8.05 | 94.2 | 32.2 | 21.9 | 6.83 | 2.3 | 89.8 | 310 | | 0.041 |
| 8/20/05 | 08:30 | 8.05 | 90.1 | 20.9 | 19.3 | 6.76 | 1.2 | 109.7 | 27 | | 0.029 |
| 9/17/05 | 08:20 | 8.37 | 94.0 | 20.4 | 19.6 | 6.95 | 1.2 | 153.6 | 128 | 102 | 0.057 |