

# New Hampshire Department of Environmental Services

## Volunteer River Assessment Program

### 2008 Programmatic Report & QAQC Audit

#### Program Summary

In 2008, VRAP supported 26 volunteer groups and 198 volunteers who monitored 334 stations on numerous rivers and watersheds throughout the state (Table 2, Figures 1 through 4). These volunteers contributed approximately 1,609 hours of time solely collecting in-situ data (Figure 3). VRAP volunteers conduct water quality monitoring on an ongoing basis. Each year VRAP has continued to grow both in terms of the number of groups participating and the amount of useable data that is collected.

#### 2008 QA/QC Summary (Table 1)

- VRAP volunteers collected **7,253** field parameters. Of these, **97%** were valid and usable for the 2010 NH Surface Water Quality Assessments.
- VRAP volunteers collected **1,392** laboratory samples. Of these, **99%** were valid and usable for the 2010 NH Surface Water Quality Assessments.
- The total number of samples (field parameters and laboratory samples) collected by VRAP volunteers was **8,645**. Of these, **97%** were valid and usable for the 2010 NH Surface Water Quality Assessments.
- A total of eight multiparameter datalogger deployments, accounting for **29,470** instantaneous data points were collected. Of these, **90%** were valid and usable for the 2010 NH Surface Water Quality Assessments.

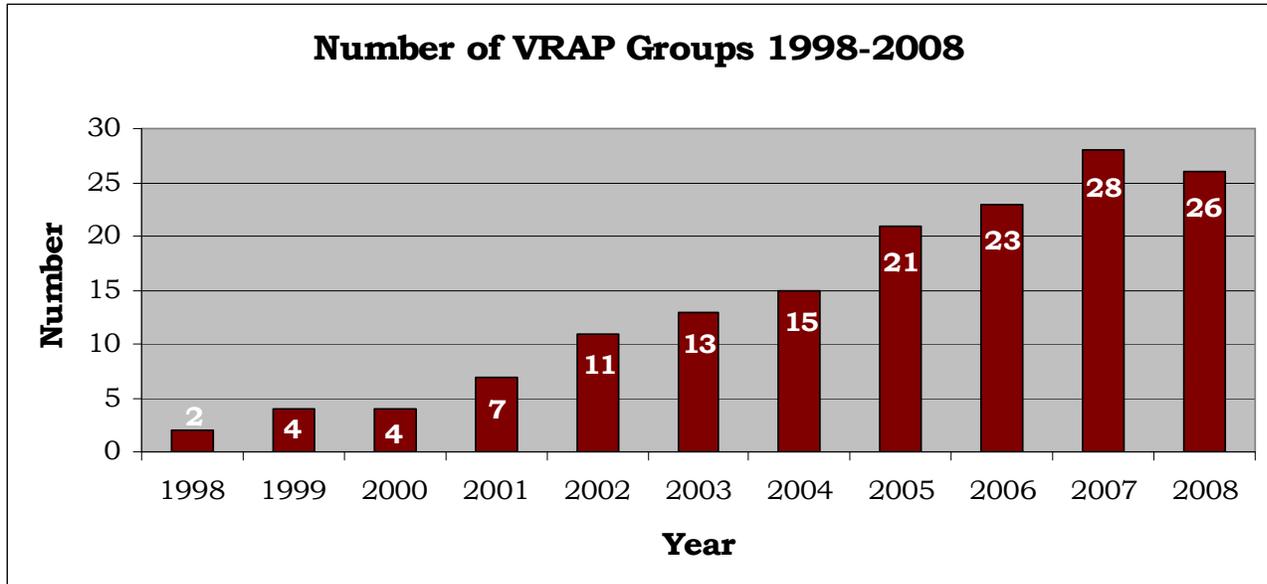
**Table 1: 2008 QAQC Data Summary Statistics**

Type of Sample	Number of Samples Collected	Number of Invalid Samples	Percent (%) Invalid Samples	% Valid Samples Usable for 2010 NH Surface Water Quality Assessments
<b>Number of Field Parameters</b>	7,253	240	3.31%	96.69%
<b>Number of Laboratory Parameters</b>	1,392	1	0.20%	99.80%
<b>Total Number of Samples (Field + Lab)</b>	<b>8,645</b>	<b>241</b>	<b>2.79%</b>	<b>97.21%</b>
<b>Total Number Datalogger Samples</b>	29,470	2,858	9.70%	90.30%

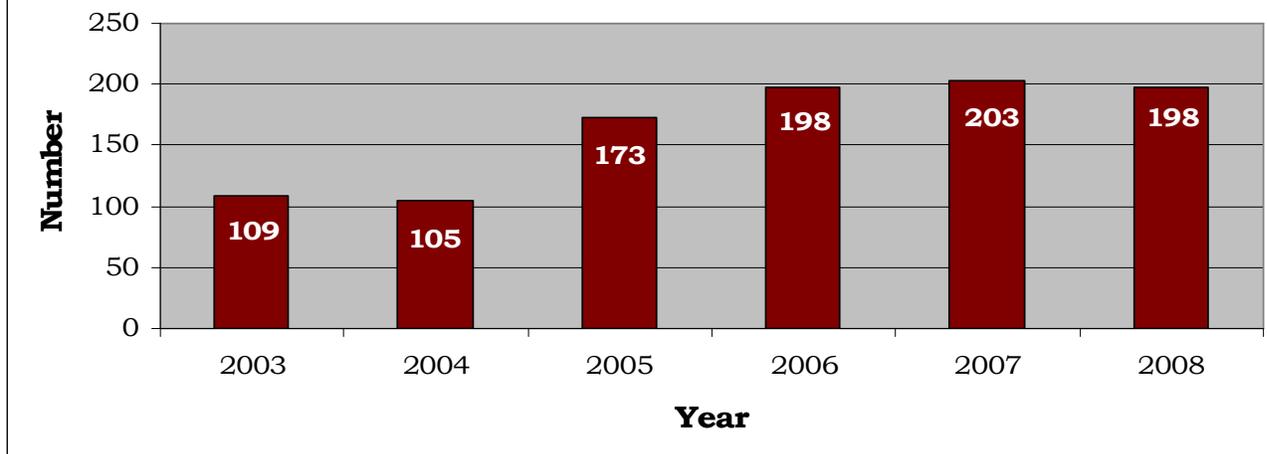
**Table 2. VRAP Group and Number of Stations Monitored - 2008**

<b>Group</b>	<b>Number of Stations Monitored</b>
1. Ammonoosuc River Local Advisory Committee	14
2. Ashuelot River Local Advisory Committee	16
3. Baker River Watershed Association	15
4. Bellamy River Watershed Association	8
5. Blackwater River VRAP Group	4
6. Cains Brook VRAP Group	8
7. Cocheco River Watershed Coalition	55
8. Cold River Local Advisory Committee	57
9. Contoocook River Local Advisory Committee	10
10. Dalton Conservation Commission (Connecticut & Johns River)	5
11. Exeter Conservation Commission	12
12. Sharon Conservation Commission (Gridley River)	4
13. Gunnison Brook VRAP Group	4
14. Hodgson Brook Advisory Committee	10
15. Hooksett Conservation Commission (Peters Brook, Browns Brook, Dalton Brook, Messer Brook)	4
16. Isinglass River Local Advisory Committee	22
17. Israel River VRAP Group	12
18. Lamprey River Watershed Association	20
19. Nashua River Watershed Association	7
20. Oyster River Watershed Association	17
21. Pemigewasset River Local Advisory Committee	9
22. Powwow River VRAP Group	7
23. Bartlett Conservation Commission (Saco River)	3
24. Wolfeboro Conservation Commission (Smith River)	2
25. Sucker Brook VRAP Group	5
26. Waterville Valley VRAP Group (Mad River & Snow's Brook)	4
<b>TOTAL NUMBER OF STATIONS MONITORED IN 2008</b>	<b>334</b>

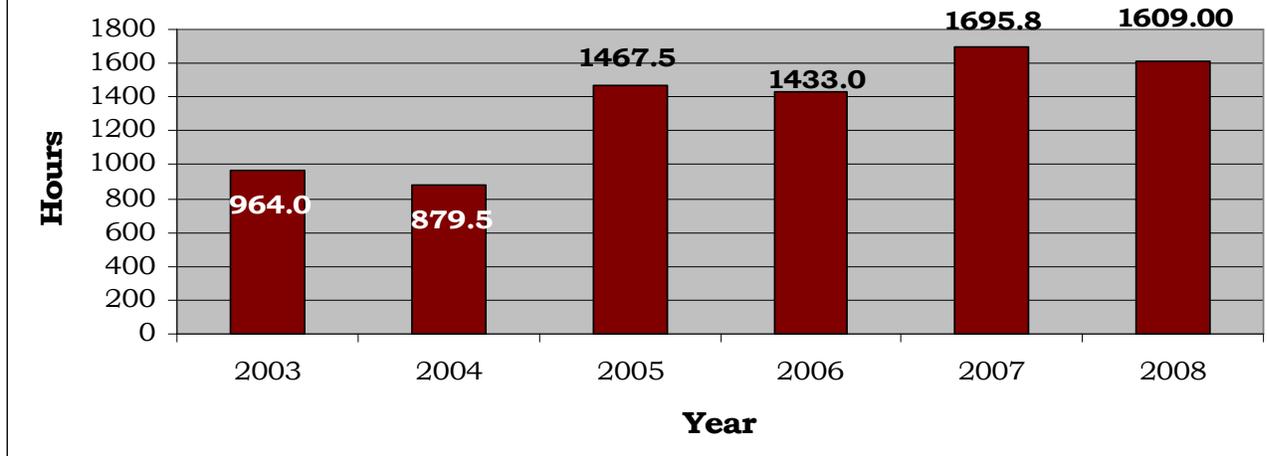
**Figure 1:**



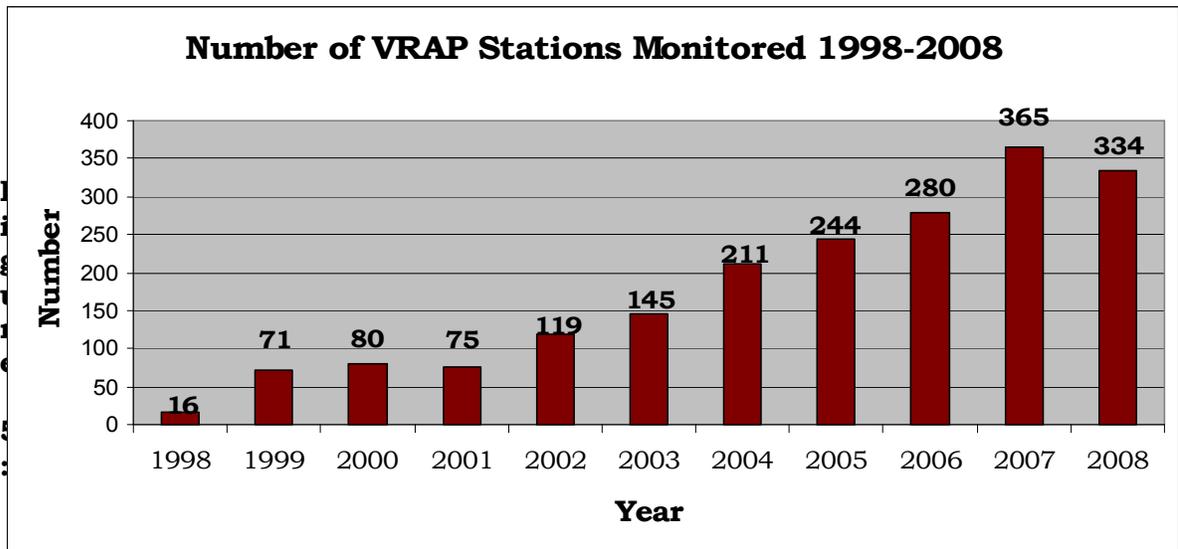
**Figure 2: Number of VRAP Volunteers 2003 - 2008**



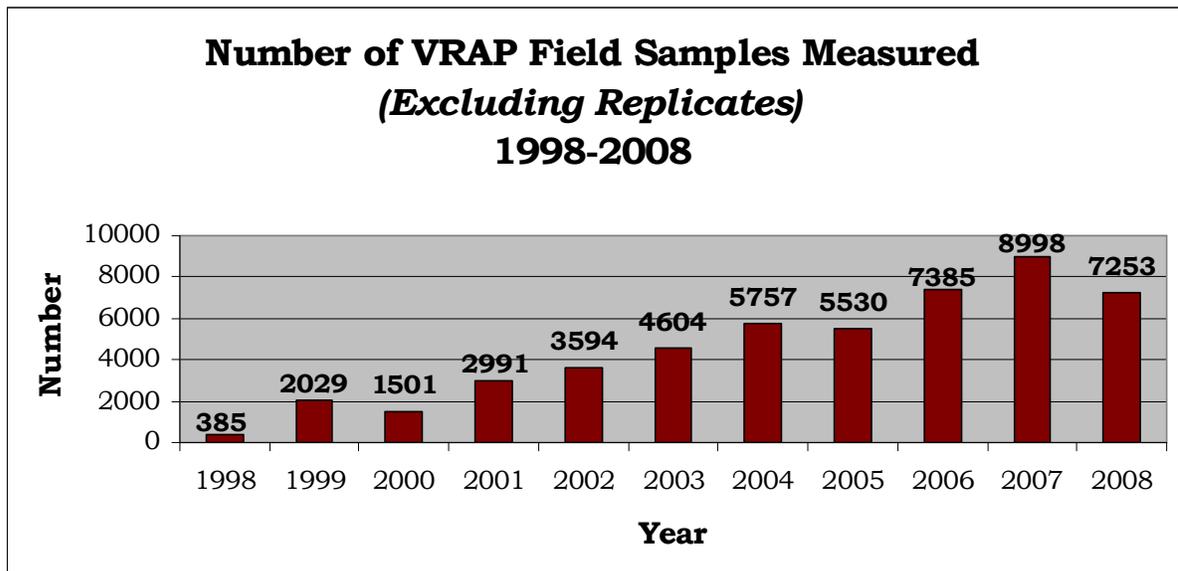
**Figure 3: Number of VRAP Volunteer Hours 2003 - 2008**



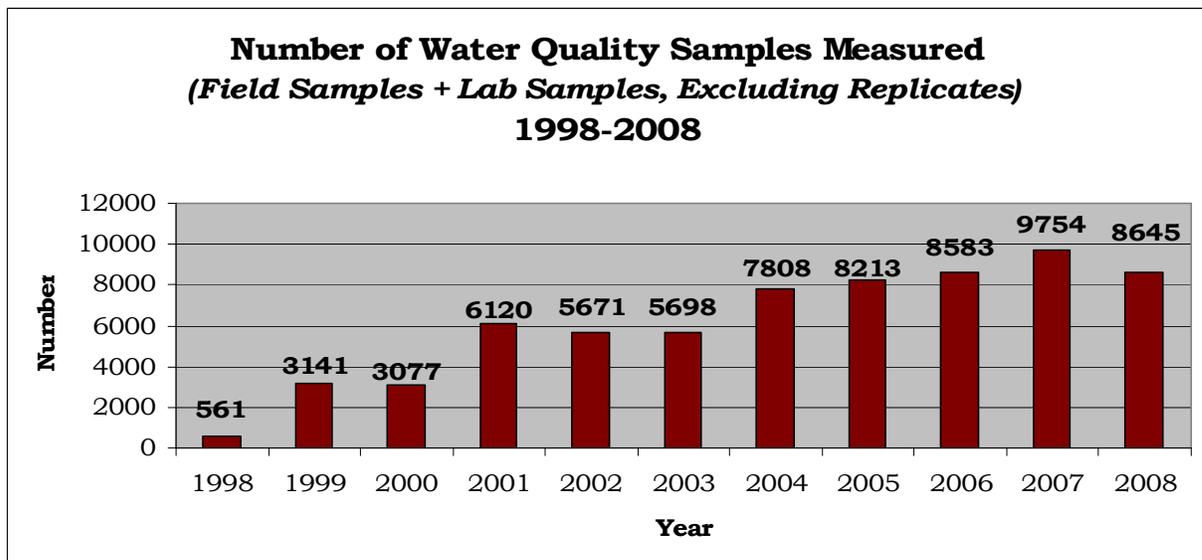
**Figure 4:**



**Figure 5:**



**Figure 6:**



**Table 3. Summary of Parameter Count for VRAP - 2008**

Parameter	Parameter Count for Routine Samples Only	Parameter Count Including Replicate Samples
<b>Field Parameters</b>		
■ Dissolved Oxygen (% Sat.)	1138	1367
■ Dissolved Oxygen (mg/L)	1138	1367
■ pH (std. units)	1138	1364
■ Specific Conductance (uS/cm)	1400	1648
■ Turbidity (NTU)	1152	1381
■ Water Temperature (C)	1287	1532
<b>Total</b>	<b>7,253</b>	<b>8,659</b>
<b>Laboratory Parameters</b>		
■ Aluminum (mg/L)	3	3
■ Cadmium (mg/L)	55	59
■ Chloride (mg/L)	226	248
■ Chlorophyll-a (mg/L)	5	6
■ Copper	52	56
■ <i>E.coli</i> (#/100mL)	497	537
■ Lead (mg/L)	61	65
■ Nitrogen, Ammonia as N	3	3
■ Nitrogen, Ammonium (NH4)	28	32
■ Nitrogen, Dissolved (mg/L)	28	32
■ Nitrogen, Kjeldahl (mg/L)	13	15
■ Nitrogen, Nitrate (NO3) as N (mg/L)	62	69
■ Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N (mg/L)	15	16
■ Phosphate (ug/L)	28	31
■ Total Phosphorous (mg/L)	233	250
■ Zinc	56	60
<b>Total</b>	<b>1,392</b>	<b>1,482</b>
<b>TOTALS</b>	<b>8,645</b>	<b>10,141</b>

## II. 2008 QA/QC VRAP SUMMARY

The QA/QC procedures incorporated into the VRAP QAPP are designed to generate data that is of sufficient quality to be useable in NHDES's 305(b) 303(d) reports. Field SOPs and protocols are written to translate the QA/QC requirements of the QAPP into terms and explanations useable by volunteer monitors. Frequent QA/QC checks by VRAP staff, field audits, and open communication lines with the VRAP groups are to ensure that proper QA/QC procedures are being followed and that a maximum of data collected is useable for assessment purposes.

### Documentation/Data Verification

Upon submission of VRAP field data sheets to NHDES, VRAP staff go through a detailed QA/QC check to determine what status the data should be flagged with in the Environmental Monitoring Database (EMD).

1. Data is manually entered into the EMD. Templates already exist in the EMD to ensure the proper scientific methods and parameter specific units are documented.
2. Data from the EMD is proofed against the original VRAP field data sheets. Any errors are corrected. If necessary VRAP staff will contact the appropriate volunteer coordinator to verify the data.
3. The data is then checked against the QAPP requirements documented in Table 2. Data that is invalidated is flagged as such in the EMD with an explanation of why the data was invalidated. (For example, "RPD of sample/replicate 23% exceeds QAPP requirements of less than 10 percent and would be flagged.) Data that is invalidated are also documented in the annual VRAP reports to each group.

The VRAP Quality Assurance/Quality Control (QA/QC) measures include a six-step approach to ensuring the accuracy of the equipment and consistency in volunteer sampling efforts.

- **Calibration:** Prior to each measurement, the pH and DO meters must be calibrated. Conductivity and turbidity meters are 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. If the same sampling schedule is used throughout the monitoring season, the replicate analysis should be conducted at different stations. Replicates should be measured within 15 minutes of the original measurements.
- **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 Solution:** 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 (De-Ionized) 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.
- **End of the Day Conductivity and Turbidity Meter Check:** At the conclusion of each sampling day, the conductivity and turbidity meters are re-checked against a known standard.

## 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. Table 4 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 4. 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	RPD < 10% or Absolute Difference <0.8 C.	Repeat Measurement	Volunteer Monitors	Precision
Dissolved Oxygen	Measurement Replicate	RPD < 10%	Recalibrate Instrument Repeat Measurement	Volunteer Monitors	Precision
	Known Buffer (Zero O <sub>2</sub> Sol.)	RPD < 10% or Absolute Difference <0.4 mg/L	Recalibrate Instrument Repeat Measurement	Volunteer Monitors	Relative Accuracy
pH	Measurement Replicate	Absolute Difference <0.3 pH units	Recalibrate Instrument Repeat Measurement	Volunteer Monitors	Precision
	Known Buffer (pH = 6.0)	± 0.1 std units	Recalibrate Instrument Repeat Measurement	Volunteer Monitors	Accuracy
Specific Conductance	Measurement Replicate	RPD < 10% or Absolute Difference <5µS/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	RPD < 10% or Absolute Difference <1.0 NTU	Recalibrate Instrument Repeat Measurement	Volunteer Monitors	Precision
	Method Blank (DI Water)	± 0.1 NTU	Recalibrate Instrument Repeat Measurement	Volunteer Monitors	Accuracy
Laboratory Parameters	Measurement Replicate	RPD < 20% or Absolute Difference less than ½ the mean value of the parameter in NHDES's Environmental Monitoring Database	Repeat Measurement	Volunteer Monitors	Precision

### **III. SUMMARY OF 2008 QA/QC RESULTS**

#### **A. Description of Training Activities**

##### **For Volunteers:**

- During April and May 2007, VRAP organized 14 training workshops. Training workshops were held in Rochester, New Boston, Claremont, Portsmouth, Franklin, Keene, Rollinsford, Littleton, Epping, Exeter, Webster, Warner, and Dalton. One hundred eighty seven volunteers attended the events. Topics included: calibration and meter checks, quality assurance and quality control, sample collection for field and laboratory analysis, order of field tests, sampling techniques, and instruction on water quality parameters and state standards.
- From May through October 2007, 27 field audits were conducted by VRAP staff. Twenty VRAP groups were audited. Four groups were audited more than once, either because they were a newly established group, or they were an existing group that needed additional assistance. To facilitate this process, the “*Field Sampling Procedures Assessment*” data sheet was revised and used to assess sampling procedures during the field audit.

##### **For the VRAP Intern:**

The VRAP intern hired for the 2008 season was new to the program.

- The VRAP intern was trained on proper use of hand-held water quality sampling equipment and in-situ multiparameter dataloggers according to the approved SOPs. This instruction was given both in the “classroom” (NHDES office and laboratories in Concord) as well as in the field.
- The VRAP intern was trained on proper laboratory sampling techniques, collection methods, sample volumes, container sizes/types, as well as preservative requirements and holding times at the NHDES office and laboratories in Concord as well as in the field.
- The VRAP intern also accompanied other NHDES Watershed Management Bureau staff and experienced interns on several field days for additional training. Additional trainings would have occurred if the VRAP intern had not been comfortable with the instrumentation or procedures.

#### **B. Documentation of Usable Data Versus Actual Data Collected**

##### **Field Measurements and Grab Sampling**

VRAP staff reviewed all results from field sampling and laboratory analysis. Comments relative to the field data were written directly on the field data sheets, whereas comments relative to laboratory data were written directly on the laboratory results sheets. Table 5 summarizes the number of data points collected for each parameter and the corresponding number and percent of invalid data. During 2008, 8,645 instantaneous data points were collected via the VRAP program. Of these, 255 or 2.95 percent were ruled invalid (Table 5).

Data was classified as invalid if calibrations were not conducted, replicates did not meet the requirements in Table 4, or the program manager had other reasons to question the validity of the data. The invalid data were input to the Environmental Monitoring Database (EMD), but will not be used for surface water quality assessment purposes. Invalid data is specifically flagged in the EMD as such.

**Table 5. Summary of Data Verification - 2008**

Parameter	Parameter Count for Routine Samples Only	Invalid Count	% Invalid
<b>Field Parameters</b>			
■ Dissolved Oxygen (% Sat.)	1138	48	2.03%
■ Dissolved Oxygen (mg/L)	1138	66	3.82%
■ pH (std. units)	1138	6	0.03%
■ Specific Conductance (uS/cm)	1400	79	4.47%
■ Turbidity (NTU)	1152	37	1.19%
■ Water Temperature (C)	1287	4	0.01%
<b>Total</b>	<b>7,253</b>	<b>240</b>	<b>3.31%</b>
<b>Laboratory Parameters</b>			
■ Aluminum (mg/L)	3	0	0.00%
■ Cadmium (mg/L)	55	0	0.00%
■ Chloride (mg/L)	226	0	0.00%
■ Chlorophyll-a (mg/L)	5	0	0.00%
■ Copper	52	0	0.00%
■ <i>E.coli</i> (#/100mL)	497	1	0.20%
■ Lead (mg/L)	61	0	0.00%
■ Nitrogen, Ammonia as N	3	0	0.00%
■ Nitrogen, Ammonium (NH4)	28	0	0.00%
■ Nitrogen, Dissolved (mg/L)	28	0	0.00%
■ Nitrogen, Kjeldahl (mg/L)	13	0	0.00%
■ Nitrogen, Nitrate (NO3) as N (mg/L)	62	0	0.00%
■ Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N (mg/L)	15	0	0.00%
■ Phosphate (ug/L)	28	0	0.00%
■ Total Phosphorous (mg/L)	233	0	0.00%
■ Zinc	56	0	0.00%
<b>Total</b>	<b>1,392</b>	<b>1</b>	<b>0.20%</b>
<b>TOTALS</b>	<b>8,645</b>	<b>241</b>	<b>2.79%</b>

## Submersible Multiprobe Datalogger Measurements

In addition to collecting data via instantaneous readings and laboratory samples, VRAP uses multiparameter dataloggers to collect water quality data. The multiparameter dataloggers are capable of measuring dissolved oxygen (mg/L and % sat.), pH, conductivity, and water temperature. All dataloggers can record data at a user-defined time interval (generally 15 minutes).

The dataloggers are calibrated prior to deployment and QA/QC checked upon retrieval. On a parameter by parameter basis each deployment is flagged in the EMD as valid or invalid. VRAP staff will also look at the data and invalidate individual data points where necessary, e.g., probe failure, data collected out of water. During 2008, a total of eight multiparameter datalogger deployments accounting for 29,470 instantaneous data points were collected (Table 6). Of these, 2,858 or 9.70 percent were ruled invalid (Table 7).

**Table 6. Summary of VRAP Datalogger Deployments – 2008**

Station	Waterbody Name	Town
12-ISG	Isinglass River	Strafford
07-ISG	Isinglass River	Barrington
02-ISG	Isinglass River	Rochester
10-PIS	Piscassic River	Freemont
08-PIS	Piscassic River	Epping
07-PIS	Piscassic River	Epping
07-WIL	Willow Brook	Rochester
01-WIL	Willow Brook	Rochester

**Table 7. Summary of Multiparameter Datalogger Data Verification - 2008**

Parameter	Total Count	Invalid Count	% Invalid
Dissolved Oxygen (mg/L)	5,894	1,429	24.20%
Dissolved Oxygen (% Sat)	5,894	1,429	24.20%
pH (std. units)	5,894	0	0.00%
Specific Conductance (uS/cm)	5,894	0	0.00%
Water Temperature (C)	5,894	0	0.00%
<b>TOTALS</b>	<b>29,470</b>	<b>2,858</b>	<b>9.70%</b>

### C. Use and Effectiveness of Corrective Actions

Corrective actions were rarely necessary during the sampling season. VRAP staff remained in contact with VRAP group leaders and volunteers throughout the year and immediately communicated any problems with the data or sampling techniques. When questions or problems did arise they were quickly corrected.

### D. Conformance to QAPP Requirements/Descriptions of Deviations

Table 8 shows the inconsistencies with the approved VRAP QAPP during the 2008 monitoring season.

**Table 8: Non-Conformances with the Approved NHDES VRAP QAPP Identified Following the 2008 VRAP Monitoring Season**

QAPP Inconsistency No.	QAPP Section	Description	QAPP/SOP Inconsistency	Reconciliation of QAPP Inconsistency
2008-01	4.4	Training Certification Form	The VRAP QAPP indicates that each volunteer and volunteer group coordinator must participate in an annual training workshop and this training must be documented. Given that some of the group coordinators have been monitoring for over 5 years a “train the trainer” session was established whereby the volunteer group coordinator can attend the annual training workshop and then retrain veteran volunteers and train new recruits. This also allows for the recruitment of new volunteer monitors during the monitoring season when the training sessions have been completed.	The current VRAP QAPP will be revised accordingly.  Documentation of those coordinators participating in the “train the trainer” session is being documented.
2008-02	5.1	Project Planning Meetings	QAPP indicates that formal planning meeting should be held with each group annually to discuss monitoring plan. In 2008, each group was required to complete and submit an “Individual Group Monitoring Plan”. Only one group failed to submit the form.	The current VRAP QAPP will be revised accordingly.  “Individual Group Monitoring Plan” forms from each VRAP group are kept on record, both electronically, and as hard copy.
2008-04	7.2	Measurement Performance Criteria	<u>Precision – Turbidity</u> : If replicate pairs had turbidity values of >10 NTU, an RPD of <10% was used to validate or invalidate data. Similarly, if replicate pairs had turbidity values of ≤ 10 NTU, an absolute difference of 1.0 NTU was used to validate or invalidate data.	The current VRAP QAPP will be revised accordingly. This change is consistent with the ARMP program. QAQC checked and data validation adjusted to accommodate new precision standard.
2008-05	7.2	Measurement Performance Criteria	<u>Precision – E. coli</u> : The approved RPD for <i>E. coli</i> bacteria was exceeded on a number of occasions, but the data were flagged as “Valid” in the EMD. This will not reduce the quality of the data.	The RPD was changed from 50% and 20% to 100% for all replicate samples.  The current VRAP QAPP will be revised accordingly.

QAPP Inconsistency No.	QAPP Section	Description	QAPP/SOP Inconsistency	Reconciliation of QAPP Inconsistency
2008-06	7.2	Measurement performance criteria	<u>Relative percent difference (RPD) and absolute difference between replicate samples:</u> Acceptance limits were revised for water temperature, dissolved oxygen, pH, specific conductance, turbidity, nitrate+nitrite, total Kjeldahl nitrogen, ammonia, BOD <sub>5</sub> , hardness, alkalinity, total solids, total suspended solids, <i>E. coli</i> , aluminum, and chlorophyll <i>a</i> .	Alternative acceptance limits were used and were based on a statistical analysis of existing VRAP/ARMP data. This will not reduce the quality of the data.  The current VRAP QAPP will be revised accordingly.
2008-07	13.1	Sampling Quality Control	<u>Field Duplicates:</u> During the 2008 season VRAP groups were not required to collect duplicate samples as they had in the past. This decision was made due to the inability to determine if any variability between the duplicate and sample was due to instrument issues or true environmental variability.	The current VRAP QAPP will be revised accordingly. This will not reduce the quality of the data or its ability to be flagged as valid.
2008-08	13.1	Sampling Quality Control	Frequency of Replicates: VRAP groups are instructed to conduct a replicate on each sampling day for field parameters. In cases where there was no field replicate conducted, the 10% replicate requirement was used and the replicate for the previous or next sampling event was used for QA/QC purposes on the date without a replicate.	The current VRAP QAPP will be revised accordingly. This will not reduce the quality of the data or its ability to be flagged as valid.
2008-09	16.1	Technical System Audits	Technical system audits were conducted for 76.9% of VRAP groups whereas the QAPP requires that all groups be audited. In addition some audits were conducted in conjunction with field visits to groups for other purposes. All of the groups that did not receive audits are experienced in sampling techniques and QA/QC procedures and have experienced group leaders. This did not reduce the quality of the data collected as all data was still subject to the QA/QC procedures described in the VRAP QAPP.	An effort will be made to audit all VRAP groups during the 2009 season regardless of the number of years they have been participating. If this is not possible a priority will be given to new groups and those deemed by the Program Manager and Program Coordinator as in need of an audit.

<b>QAPP Inconsistency No.</b>	<b>QAPP Section</b>	<b>Description</b>	<b>QAPP/SOP Inconsistency</b>	<b>Reconciliation of QAPP Inconsistency</b>
2008-10	17.0	QA Management Reports	The prescribed QA Memorandum will not be completed.	The NHDES QA System Annual Program Self-Audit will be completed instead of the prescribed QA Memorandum.  The current VRAP QAPP will be revised to state that the self-audits will be conducted annually.
2008-11	Appendix A	Field Sampling Protocols	The field sampling protocols in the approved QAPP were not used during 2008	The field sampling protocols were modified to reflect changes in QA/QC procedures listed above. The use of the revised field protocols will not reduce the quality of the data.
2008-12	Appendix B	VRAP Sampling Plan and Analysis Template	The sampling template in the approved QAPP was not used in 2008.	VRAP staff allowed for flexibility in how a sampling plan was documented as long as sampling QA/QC requirements were met. This will not reduce the quality of the data.
2008-13	Appendix C	VRAP Field Data Sheet	The Field Data Sheet in the approved QAPP was not used in 2008. This will not reduce the quality of the data.	Field data sheet updated and improved to reflect changes in QA/QC requirements and to reflect minor changes requested by VRAP groups.