Boulder Creek Watershed Initiative
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March 29, 2010

Dear Mr. Sturm,

The Boulder Creek Watershed Initiative (BCWI) respectfully submits this Final Project Grant Report to the Healthy Rivers Fund for work accomplished regarding BCWI's volunteer water quality monitoring Stream Team Program. Throughout 2009 and into 2010 BCWI has administered the water quality monitoring Stream Teams that have collected a full years worth of data for 2009.

Work accomplished to satisfy all grant requirements include all tasks outlined for the Stream Team project:

- Two agency meetings
- Volunteer recruitment
- Two volunteer trainings
- Two volunteer certifications
- Order and purchase water quality equipment
- Midway project grant report
- Two water quality information sessions
- Twelve monthly sampling sessions at seven sites
- Stream Team water quality report
- Final project grant report
- Expense incurred, mostly mileage and printing

Water sampling and analysis was the strength of BCWI's efforts for 2009. The Eldora Stream Team sampled a total of six times (Middle Boulder Creek at Marysville Bridge). Inclement weather prevented them from sampling during most winter months. The South Boulder Creek Stream Team sampled a total of 12 times (SBC at Bobolink Trailhead). Both these Stream Teams are self sufficient and need little guidance to conduct their monthly sampling. The Louisville Stream Team sampled 11 times (above Coal Creek Golf Course). The CU Wild Stream Team sampled a total of 10 times (Bear Creek at Arapahoe and Foothills). Although CU Wild was active during the school year, BCWI staff conducted the sampling events during the summer. The Patagonia Stream Team sampled a total of 10 times (4 Mile Creek at confluence with Boulder Creek). Finally, BCWI staff sampled two locations on our own during most of 2009. The first location (Goose Creek at 30th and Mapleton) was sampled a total of 12 times while the second location (Boulder Creek at Weld County Road 20.5) was sampled 11 times. The five active Stream Teams consist of a total of 23 individuals.

Data collected in 2009 will not be posted on our website or made public because of data integrity issues. In the past two years of data collection (2008 and 2009) the cities of Boulder and Louisville and Boulder County have stated that until we upgrade our equipment and protocols, they will not accept our data as valid for their use. However, data collected to date will act as baseline information for our future studies. Additionally, we have noticed some *consistently* high numbers at some of our sites including:
* High nitrate and phosphate at the Coal Creek site
* High phosphate readings at the Bear Creek site
* High nitrate and phosphate readings at the 30th and Mapleton site
* High nitrate, phosphate and pH at Weld County Road 20.5 site
Please refer to Appendix C in the 2009 Stream Team Report for an overview of all data.

BCWI has been able to keep the monthly sampling and analysis active despite the fact that the Program Manager is now working a full time job for another organization and has little time to administer the Stream Team program. Despite this managerial shortcoming, Stream Team volunteers have been diligent in continuing to sample their respective sites.

Moving forward, funding from Healthy Rivers Fund has enabled BCWI to upgrade the entire program via the purchase of new water quality equipment and the incorporation of our efforts into the the statewide River Watch Program run by the Colorado Watershed Assembly. The new equipment and protocols for BCWI's Stream Team Program are both EPA and State of Colorado certified and will enhance the scientific integrity of the data collected. This move to the River Watch Program should satisfy data integrity needs in the future, especially with the stringent Quality Assurance/Quality Control mechanisms built in for both sampling & analysis and data review.

There are some additional changes in store for the 2010 program. Firstly, due to consistently low flow at the Coal Creek and Bear Creek sites, we will discontinue monitoring these two locations. The Louisville Stream Team will now be monitoring a site downstream on Coal Creek and to the east of the City of Louisville. The CU Wild Stream Team will now be monitoring at 30th and Mapleton and the newly trained and certified USGS Stream Team will be monitoring at the Weld County Road 20.5 site. Both these sites had previously been monitored by BCWI staff. Finally, to replace the Bear Creek site, The US Forest Service will now be monitoring a site in the upper portions of the watershed, specific location to be determined.

In terms of funding for the program in 2010, the local Patagonia store not only has their own sampling site, but they also provided BCWI with two grants totaling $3000 to continue our water quality monitoring efforts. BCWI has also received a $3000 grant from Boulder County for an E-Coli study this summer where all seven sampling sites will be tested from June through October, 2010.

BCWI is proud to have had the opportunity to protect the waters of the Boulder Creek watershed via the continuation of this very important volunteer water quality monitoring Stream Team Program. Along with the support of our partners, BCWI is especially grateful to the Healthy Rivers Fund for giving us the opportunity to train the people of Boulder County in water quality monitoring in an effort to better enable *them* to become stewards of their watershed resources.

Please feel free to contact me with any questions or comments concerning this Final Grant Progress Report.

Sincerely,

Paul Hempel

Boulder Creek Watershed Initiative

Boulder Creek Watershed Year 2009 Stream Team Report

Issued By:

Boulder Creek Watershed Initiative

January 30, 2010

Mission Statement:

To protect and enhance the health of the Boulder Creek watershed by community based stewardship through education, information and action

Boulder Creek Watershed Initiative
Stream Team Report:

Written and Produced by Paul Hempel

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1. Learning About Boulder Creek

This final Stream Team Report is a presentation of water quality data collected by Boulder Creek Watershed Initiative (BCWI) Stream Team volunteers for the year 2009. The data is displayed in tables for the purposes of this report. This information can be used to increase knowledge and awareness about the relationship between water quality and the health of Boulder Creek and its tributaries. The baseline of water quality information provided here represents an effective tool for observing trends over time and space and can act as a reference point for future data collection.

2. How to Use this Report

The sections that lead to the specific data descriptions provide historic information about the watershed, availability of historic data, description of water quality sampling sites, and the methodology that BCWI has implemented within its water quality monitoring program.

With this report BCWI is providing the raw data and the baseline information (in appendices) for future comparisons of data. Initial interpretation regarding trends and ecosystem health begins with this data set. Others are strongly encouraged to review this data, whether it is for general research, to inform public debate on water quality issues, for educational purposes, or for other reasons. BCWI plans to present this report during our Watershed Forum series in an effort to inform a broader constituency about the Boulder Creek watershed's water quality status and issues.

3. The Boulder Creek Watershed

Central to the landscape of Boulder County, Colorado is the Boulder Creek Watershed, an 1160 square kilometer basin that encompasses mountains, foothills, and plains (Figure 1). Boulder Creek and its tributaries originate as headwater streams at the Continental Divide and flow through historic mining districts, agricultural fields, and the communities of Nederland, Boulder, Arvada, Eldorado Springs, Lafayette, Louisville, Superior and Erie. The water in Boulder Creek flows into the Saint Vrain River and then the South Platte River, eventually ending up in the Mississippi River and the Gulf of Mexico.

a. Environmental Setting: The Boulder Creek Watershed lies within two physiographic provinces. The mountainous upper watershed is part of the Southern Rocky Mountain Province and is characterized by deep, steeply sloping valleys. The flatter, lower watershed is part of the Colorado Piedmont Section of the Great Plains province and slopes gently to the northeast. The two regions differ substantially in geology, climate, and land cover.

b. Land Cover and Use: The upper watershed consists primarily of forest, shrubs and alpine tundra. The lower watershed consists of grassland, agricultural land, and urban/developed land. Agricultural lands consist of pasture and fields of alfalfa, wheat, corn and barley. Metal and coal mining fueled settlement of the watershed in the late 1860's. Urbanized land of the plains and foothills has increased substantially in the past 30 years in areas that were previously forest, grassland, or agricultural land. Reservoirs have increased in number and size, sand and gravel is mined along Boulder Creek and oil and natural gas are extracted in the eastern part of the watershed.

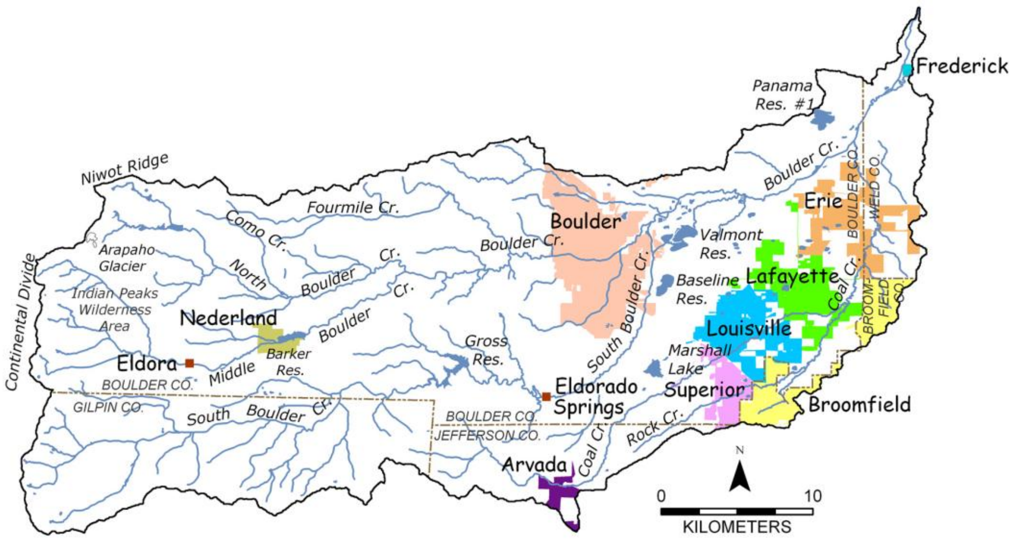

Figure 1: Boulder Creek Watershed, Sheila Murphy, USGS

c. Hydrology: Streamflow in Boulder Creek originates primarily as snowmelt near the Continental Divide, so discharge varies seasonally and annually depending on snowpack depth and air temperature. Low-flow conditions occur from October to March; high flow conditions occur from May to July and usually peak in June. Discharge (flow rate) of Boulder Creek and its tributaries is recorded by several streamflow-gaging stations. Stream discharge data are important in allocating water rights, estimating flood potential, and evaluating long term changes in hydrology and water quality.

d. Management: Boulder Creek and its tributaries are part of a complex water management system. Diversions remove water from streams for municipal, industrial and agricultural use. Reservoirs store water for a reliable year-round supply. Water is brought into and out of the watershed by transbasin diversions. Wastewater treatment plants contribute treated effluent that can account for a substantial portion of flow in streams in the lower watershed during low-flow conditions.
(S.F. Murphy, USGS, 2006)

e. Challenges and Opportunities:

* Population in the Boulder Creek Watershed grew by over a third since 1990; this has led to a corresponding one-third decrease in farmland acres and increased urbanization. Urbanization can lead to degradation of streambank riparian areas and introduce pollutants such as oil, metals, road salt, sediment, nutrients, and pesticides to streams.
* Two invasive species, the New Zealand Mud Snail and the Eurasian watermilfoil, have been accidentally introduced to Boulder Creek and its tributaries. These species have no natural predators in the watershed, and spread rapidly. In addition, the diatom Didymosphenia geminata has formed excessive growths in Boulder Creek. These species outcompete native species and reduce biodiversity.

* Treated effluent from several wastewater plants dominates the chemistry of lower Boulder Creek and Coal Creek, in part due to diversion of upstream flow. Studies by the U.S. Geological Survey and the University of Colorado have shown that effluent entering Boulder Creek contains endocrine-disrupting compounds that have altered the sex of fish in the creek.

* The flow of water in South Boulder Creek during winter months is insufficient to sustain healthy aquatic ecosystems due to municipal and agricultural diversions.

Figure 2. Boulder Creek in Boulder, Colorado

4. Boulder Creeks Water Quality

Water quality and quantity in the watershed influence water uses, recreational pursuits (including angling and various forms of boating), and wildlife habitat dependent on flowing streams within the Boulder Creek watershed. As land uses have changed, so have water quality issues – with a historic focus on heavy metals from mining entering streams, and runoff from agricultural practices. Presently, attention has shifted to the influence of development pressures on Boulder Creek and its tributaries through wastewater treatment discharges, storm water runoff, and increased erosion and sediment-loading.

The mainstem of Boulder Creek, as well as all tributaries from the source to the confluence with the Saint Vrain River are categorized as Boulder Creek Basin, segments 1 through 12 by the State of Colorado's Water Quality Control Commission (WQCC). All tributaries to Boulder Creek within the Indian Peaks Wilderness Area have been classified as Outstanding Resource Waters by the WQCC. The remaining segments of Boulder Creek and its tributaries have been classified by the WQCC as follows: Aquatic Life Coldwater – Class 1 (upstream portion to confluence with South Boulder Creek), Aquatic Life Warmwater – Class 1 (downstream portion to confluence with Saint Vrain River, Recreation – Class 1a, Water Supply, and Agriculture. Section 8 provides more detailed discussion of the significance of these classifications (CDPHE, 2005) (Appendix A).

States are required by section 305(b) of the federal Clean Water Act to assess and report on the quality of the State's waters to Congress through the USEPA. Section 305(b) reports describe the ways a State measures water quality, the quality of water bodies in the State, and pollution-control programs. The State of Colorado 305(b) report is available from the CDPHE (2005c, d).

When credible data on the water quality of a stream or lake indicate that a standard is not met, the State proposes that the stream segment be placed on a list of impaired segments, called the "303(d) list." The Colorado Water Quality Control Commission has a public hearing to consider recommendations and adopts Colorado's 303(d) list as a State regulation. The USEPA accepts the 303(d) list from the State or can list additional segments. The 303(d) list identifies the component(s) (such as nitrate, lead, or sediment) that is (are) causing water-quality concerns for that water body. Some stream segments in the Boulder Creek Watershed have been on the 303(d) list for ammonia and E. coli (CDPHE, 2005c, d).

The State is required to prioritize water bodies on the 303(d) list based on the severity of impairment and other factors. It will then determine the causes of the water-quality concern and allocate responsibility for the impairment. This analysis is called the Total Maximum Daily Load (TMDL) process. The State of Colorado also identifies water bodies where there is reason to suspect water-quality impairment, but uncertainty exists about data quality or the cause of impairment. These waters are placed on the Monitoring and Evaluation (M&E) List (CDPHE, 2005c, d). Some stream segments in the Boulder Creek Watershed have been on the M&E list for aquatic life, E. coli, selenium, and chromium VI. (Figure 2).(S.F. Murphy, USGS, 2006)

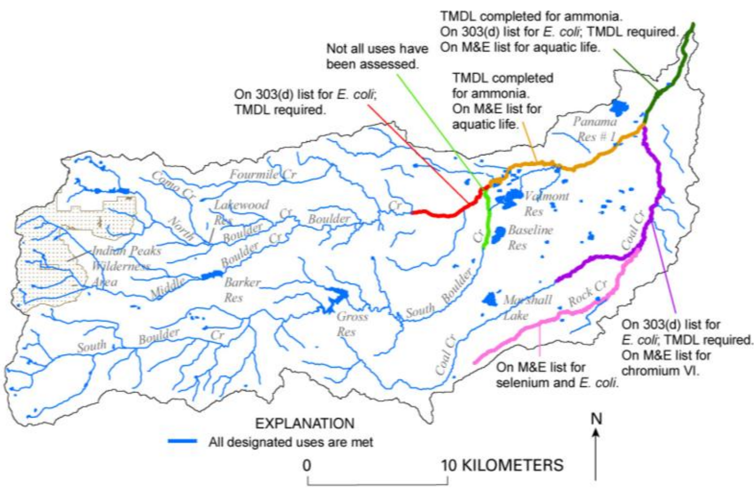

Figure 3: Segments not meeting designated uses in the Boulder Creek Watershed, 2005 (CDPHE, 2005c).

<u>5. Available Water Quality Information</u>

BCWI has investigated entities that have historically conducted water quality monitoring in the Boulder Creek watershed. These entities were contacted for information about parameters sampled, sample frequency and site locations, type of analysis used, and flow gage information. By charting gaps in sampling efforts and water quality information, BCWI saw this as the first step in the design of a comprehensive, coordinated water quality monitoring program.

The following entities have historically conducted water quality monitoring in the Boulder Creek watershed:

- ♦ United States Geologic Survey (USGS)
- ♦ Colorado Department of Public Health and Environment (CDPHE)
- ♦ Colorado Division of Wildlife (CDOW) River Watch sites (area schools)
- ♦ Boulder County
- ♦ Municipalities
- ♦ Wastewater treatment facilities
- ♦ United States Forest Service: monitoring of high mountain lakes

The investigation into historic water quality monitoring found a number of opportunities to build upon efforts that existed as of 2006 in the Boulder Creek watershed. The fact that so many different entities were testing water quality highlighted the excellent chance of building a strong community initiative for a more comprehensive and consistent monitoring program.

6. BCWI's Water Quality Monitoring Program

In 2009 BCWI continued a comprehensive water quality monitoring program in order to better understand and define the overall chemical, biological, and physical health of Boulder Creek and its tributaries. Utilizing citizen volunteers to address water quality concerns was identified in BCWI's Boulder Creek Community Stewardship Plan completed in 2007. To date, five water quality monitoring Stream Teams consisting of 28 volunteers have been sampling in Nederland, Boulder (3) and Louisville.

Overall Stream Team Program Objectives include:

- Educate people about their relationship to streams and watersheds
- Provide public involvement opportunities to protect local streams
- Protect water resources through pollution prevention and water conservation.

BCWI is currently collaborating with the Keep it Clean Partnership (KICP), the City of Boulder (COB) and the United States Geological Survey (USGS) for water quality monitoring and protection activities. KICP is helping to administer the Stream Team program and is collaborating with BCWI in agency program planning and volunteer recruitment, training and management and, data management. USGS is supplying technical support. COB is providing staff time and technical support.

Three sets of water quality monitoring equipment were utilized by the Stream Teams (Appendix B). Included in the parameters monitored were flow, temperature, pH, dissolved oxygen, conductivity, nitrate and phosphate.

Important note: Contrary to the original assumption that data collected in the first two years of the program would be distributed to various agencies, the general public and other interested parties and, posted on the internet, the BCWI and KICP technical committee decided to further evaluate that information to ensure that the quality of data collected during the first year of the program are representative and that precision and accuracy are clearly understood. *Therefore, the* *data found in the data tables should be used for informational purposes only and are not to be interpreted as a reflection of precise measurements taken at the various sampling locations.*

The main purpose of designing, implementing, and carrying out a water quality monitoring program for the Boulder Creek watershed was to gather baseline data of various chemical parameters over time. In the year 2009, BCWI accomplished its first “snapshot” of this effort. How this monitoring program evolves over time has been and will continue to be evaluated, and a discussion of the future of the monitoring program is provided in Section 9.

a. Planning Meetings: BCWI conducted meetings with representatives from the appropriate water resources departments around Boulder County to finalize the water quality monitoring plan for 2009. This included the incorporation of volunteers into the project. The location of water quality monitoring sites, the establishment of sampling dates, and an overview of the parameters to be sampled and monitoring equipment to be used was discussed.

b. Volunteer Recruitment: Volunteers who had been previously identified through the BCWI/KICP summer 2007 outreach process and who conducted water quality monitoring in 2008 continued their monitoring efforts in 2009. Sample sites from the 2008 efforts were retained for 2009 monitoring. Two additional sites, 4 Mile Creek and Boulder Creek in Longmont were added to the 2009 effort.

c. Volunteer Training: BCWI conducted one volunteer training workshop for a new Stream Team, Patagonia. The overall goals of the project, sampling locations, dates and methods and, equipment used were explained at this time.

d. Volunteer Certification: BCWI conducted one volunteer QA/QC certification events, for the Patagonia Stream Team. Volunteers were evaluated on their sampling procedures and data collection techniques. This was to insure that volunteers could effectively accomplish monitoring tasks before they participated in a regular sampling event.

Figure 4: Chemetrics Water Quality Equipment for DO, Phosphate and Nitrate

After the initial training session was completed, Patagonia Stream Team participants were required to practice the methods on their own. BCWI staff then conducted a follow-up visit with the Patagonia Stream Team to check on the quality and accuracy of the team's sampling and analysis techniques. Once the Stream Team was certified through this process, it began conducting sampling and analysis under no supervision.

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Figure 5: Eldora Stream Team volunteers brave the cold during a water quality sampling session.

e. Water Sampling and Analysis: In the year 2009, water quality samples were collected and analyzed by BCWI volunteers at the following seven locations:
1. Middle Boulder Creek in Eldora at the Marysville Bridge
2. Coal Creek in Louisville at US 36
3. Bear Creek in Boulder at the confluence with Boulder Creek
4. Goose Creek in Boulder at 30th and Mapleton Streets
5. South Boulder Creek in Boulder at the Bobolink trailhead on Baseline Road
6. 4 Mile Creek at the confluence with Boulder Creek
7. Boulder Creek at County Road 20.5 in Longmont

Safety is a priority of the program. Volunteers are strongly encouraged to work in teams of at least two people.

Data is stored in an excel spreadsheet format, has been compiled according to each of the five sampling locations and can be found in Appendix C. Highlights of the Stream Team data collection and analysis include:

- Five stream teams performed sampling in 2009 (BCWI sampled the other two sites),
- Seven stream locations were monitored a total of 74 times throughout the year,
- Sampling occurred during all twelve months during this period,
- In-situ analyses and data gathering for each sampling event included:
    - Flow rate of stream
    - pH
    - Temperature

- Dissolved Oxygen
- Conductivity
- Nitrate
- Phosphate
- Air temperature and other weather conditions

7. Boulder Creeks' Signals: What we Measure and Why

This section provides background on what is measured for the BCWI's water quality monitoring program, what influences these parameters, how and why they fluctuate over time, and why we care about them. By understanding these specific physical, chemical, and biological variables, we can ask deeper questions about our results. The "River Continuum Concept" provides a predictive model to hypothesize what we would expect to find from the headwaters to the mouth of each river. The River Continuum Concept proposes that natural stream ecosystems may be characterized as extending continuously from their headwater beginnings to their mouth or estuary. Furthermore, this continuous stream system provides a gradient of changing physical, chemical, and biological conditions (Vannote, 1983). The following information was compiled by Sheila Murphy of the USGS:

a. Flow is the volume of water moving past a point in a unit of time. Two things make up flow: the volume of water in the stream, and the velocity of the water moving past a given point. Flow affects the concentration of dissolved oxygen, natural substances, and pollutants in a water body. Flow is measured in units of **cubic feet per second (cfs).**

b. Conductivity (Specific Conductance) is a measure of how well water can pass an electrical current. It is an indirect measure of the presence of inorganic dissolved solids, such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron. These substances conduct electricity because they are negatively or positively charged when dissolved in water. The concentration of dissolved solids, or the conductivity, is affected by the bedrock and soil in the watershed. It is also affected by human influences. For example, agricultural runoff can raise conductivity because of the presence of phosphate and nitrate.

c. Dissolved Oxygen (DO) is the amount of oxygen dissolved in the water. DO is a very important indicator of a water body's ability to support aquatic life. Fish "breathe" by absorbing dissolved oxygen through their gills. Oxygen enters the water by absorption directly from the atmosphere or by aquatic plant and algae photosynthesis. Oxygen is removed from the water by respiration and decomposition of organic matter. The amount of DO in water depends on several factors, including temperature (the colder the water, the more oxygen can be dissolved); the volume and velocity of water flowing in the water body; and the amount of organisms using oxygen for respiration. Human activities that affect DO levels include the removal of riparian vegetation, runoff from roads, and sewage discharge.

d. Nitrogen is required by all organisms for the basic processes of life to make proteins, to grow, and to reproduce. Nitrogen is very common and found in many forms in the environment. Inorganic forms include **nitrate (NO_3)**, **nitrite (NO_2)** , **ammonia (NH_3)**, and **nitrogen gas (N_2)** . Organic nitrogen is found in the cells of all living things and is a component of proteins, peptides, and amino acids. Excessive concentrations of **nitrate**, nitrite, or ammonia can be harmful to humans and wildlife. High levels of nitrate, along with **phosphate**, can overstimulate the growth of aquatic plants and algae, resulting in high dissolved oxygen consumption, causing death of fish and other aquatic organisms. This process is called ***eutrophication***. Nitrate, nitrite, and ammonia enter waterways from lawn fertilizer run-off, leaking septic tanks, animal wastes, industrial waste waters, sanitary landfills and discharges from car exhausts.

e. pH measures hydrogen concentration in water and is presented on a scale from 0 to 14. A solution with a pH value of 7 is neutral; a solution with a pH value less than 7 is acidic; a solution with a pH value greater than 7 is basic. Natural waters usually have a pH between 6 and 8.5. The scale is negatively logarithmic, so each whole number (reading downward) is ten times the preceding one (for example, pH 5.5 is 100 times as acidic as pH 7.5). The pH of natural waters can be made acidic or basic by human activities such as acid mine drainage and emissions from coal-burning power plants and heavy automobile traffic.

f. Phosphate: Phosphorus is a nutrient required by all organisms for the basic processes of life. Phosphorus is a natural element found in rocks, soils and organic material. Its concentrations in clean waters is generally very low; however, phosphorus is used extensively in fertilizer and other chemicals, so it can be found in higher concentrations in areas of human activity. Phosphorus is generally found as **phosphate** (PO_4^{-3}). High levels of phosphate, along with **nitrate**, can overstimulate the growth of aquatic plants and algae, resulting in high dissolved oxygen consumption, causing death of fish and other aquatic organisms. The primary sources of phosphates to surface water are detergents, fertilizers, and natural mineral deposits.

g. Temperature of water is a very important factor for aquatic life. It controls the rate of metabolic and reproductive activities. Most aquatic organisms are "cold-blooded," which means they can not control their own body temperatures. Their body temperatures become the temperature of the water around them. Cold-blooded organisms are adapted to a specific temperature range. If water temperatures vary too much, metabolic activities can malfunction. Temperature also affects the concentration of dissolved oxygen and can influence the activity of bacteria in a water body.

Figure 6: Volunteers at a macroinvertebrate training in 2008.

8. The Clean Water Act and Water Quality Standards

The Clean Water Act is a federal law that sets forth how the United States will restore and maintain the chemical, physical, and biological integrity of its waters (oceans, lakes, streams and rivers, ground water, and wetlands). The law provides protection of the nation's surface waters from both point and non-point pollution sources. The US EPA has delegated the administration of certain portions of the Clean Water Act program to many of the 50 states, including Colorado.

a. Clean Water Act Overview

The Clean Water Act directs public agencies and pollutant discharge permit-holders to track water quality, ranging from comprehensive national reports to monitoring data from single dischargers. The following are a few of the most important types of information available through the state water quality agencies and the EPA:

- The National Water Quality Inventory: Report to Congress
- List of Impaired Waters
- List of Permitted Discharges
- Basin-Wide Water Quality Plans
- Allocating resources for a Non-point Source Program
- Intended Use Plans
- Wasteload Allocation Studies
- National Estuary Program

Under the Clean Water Act, states establish water quality standards that define the goals and limits for all waters within their jurisdictions. Water quality standards provide the means for enforcement that support the Act's goals. In establishing water quality standards, states must undertake three major interrelated actions as specified under the Clean Water Act. They must: 1) designate uses, 2) establish water quality criteria, and 3) develop and implement anti-degradation policies and procedures. It is these standards that can be used for comparison and interpretation of the data collected for this State of the River Report.

b. Colorado Water Quality Standards

Specific to Colorado, in 1973 the State legislature passed the Colorado Water Quality Control Act, which established a procedure to protect surface waters in the State of Colorado based on their "beneficial uses." The State Act provides for a nine-member board appointed by the Governor to determine standards and other rules for water quality protection. This is the Colorado Water Quality Control Commission. Commission members are appointed from geographical areas of the state and serve three-year terms. The Commission has authority to establish regulations for water quality standards, control regulations, permit regulations for wastewater discharge, and 401certification for Army Corps of Engineers 404 permits. These regulations are reviewed every three years as to the need for changes, as required by the Clean Water Act. The Commission sets policies and guidelines for water quality programs that are carried out by the CDPHE Water Quality Control Division.

All surface waters are subdivided into "segments" that are determined by the uses of the specific stretch of water and the level of protection required to maintain those uses. Standards represent assigned values to protect the uses in each segment. A new segment is assigned when the water use or quality of water changes from the segment upstream. WQCC decisions are made by the Board based on testimony and data supplied by interested entities along those segments. This was the process through which Landis Creek's ammonia standards and aquatic life classification were lowered, as described earlier in the report.

Standards establish the maximum amount of degradation of a particular water quality parameter to which a stream segment may be exposed to from point sources (e.g. discharges from a pipe). Standards are mainly focused on regulating the **maximum** levels of pollution that may be discharged to a stream (e.g. metals) but they can also set forth **minimum** standards (e.g. dissolved oxygen). Other standards may establish a minimum *and* maximum, or range (e.g. pH).

c. Designated Use Classifications

Standards are set to protect the designated uses of a stream segment. In Colorado, these uses are broken down into one of five categories:

1) Aquatic life
2) Water supply
3) Agriculture
4) Recreation
5) Outstanding Waters

A stream may have any or all of these classifications. Criteria are developed to protect the specified beneficial use of a stream segment. Specific standards, numeric or narrative, can be established to protect the different criteria in the standards. Aquatic life protection is broken down into Class 1 and Class 2. Class 1 water has a higher level of protection (lower limits for pollution) than Class 2 water. Each of these classes is further divided into cold and warm water. Class 1 water, either cold or warm, can support a wide variety and number of individual sensitive species, while Class 2 water is unable to support such species diversity.

Standards also are applied to domestic water supplies. Water used for agriculture must be suitable for irrigation and as drinking water for livestock. Water designated for recreation is also separated into 2 classes. Class 1 has the higher level of protection and is suitable for primary contact – activities where some water might be ingested such as swimming or water skiing. Class 2 recreation waters are assumed to have less potential for swimming and boating and are used for activities such as fishing or wading.

d. Types of Stream Standards

Stream standards are either "narrative" or "numeric".

Narrative standards apply to all surface waters of the State, providing protection from human-caused or non-point sources of the following types:

- Material that can settle out to form deposits that are detrimental to use (sedimentation),
- Floating debris,
- Material that produces color, odor or taste (sludge),
- Material that is harmful to humans, plants, animals, or aquatic life,
- Material that will cause the proliferation of undesirable aquatic life (excess nutrients),
- Material that will cause a film or deposit (oil and grease).

Numeric standards fall into four categories: 1) site specific, 2) Table Value Standards, 3) Ambient quality-based, and 4) wetlands.

Site-specific standards are set for stream segments where studies have been done that show indicator species present in a stream reach. Data are presented to the WQCC and standards set to protect the species and water uses from degradation. Table Value Standards (TVS) are provided for physical and biological parameters, inorganic parameters, and metals (see Appendix A). The numeric levels are based on available information and generally protect the beneficial use of the water where site-specific standards do not appear to be needed.

The standards for inorganic and metals may also be "acute" or "chronic." An acute standard represents one-half the concentration that will kill five percent of a test population in 96 hours. The maximum standard may not be exceeded more than once in a three-year period. A chronic standard is lower, and represents the maximum concentration that still protects 95 percent of the population from growth or reproductive abnormalities. A chronic standard also may not be exceeded more than once in a three- year period. A stream standard incorporates multiple species thresholds established by compiling species-specific biological thresholds. The acute and chronic standards cover a wide range of plant and animal species. The standards for protecting the most sensitive species are those that are enforced. Also, when there is more than one use classified, the most sensitive standards will be applied. Please see Appendix B for a list of standards adopted for the Boulder Creek watershed. If a parameter is not listed in these tables, then no standards exist for it.

Sometimes standards might be a function of another parameter as in the case of some metals and water hardness. For most metals the standard is set for the dissolved fraction. In other examples, dissolved oxygen has a low standard and pH has both a high and a low standard.

Ambient quality-based standards are set for stream segments where natural or human-caused concentrations of harmful substances are higher than the TVS and cannot be reasonably lowered. Wetlands may have their own set of site-specific standards, or are covered by standards that protect the stream segment with which they are most directly connected.

9. Future Directions

Additional funding via the Healthy Rivers Fund saw BCWI train and certify one additional Stream Team in 2009, Patagonia, and one in 2010, the USGS.

In the first full year of data collection, the purpose of BCWI's water quality monitoring Stream Team program was to gather baseline water chemistry information in order to evaluate the chemical health of Stream Team sampling sites chosen for Boulder Creek and its tributaries. It is now important to review what questions we asked when we first initiated the program and if the data collected has answered these questions. For instance, did the data collected meet WQCC stream standards? If not, why? Have we established a solid baseline monitoring program with which to compare future data and establish trends? Are we sampling in the proper locations, at the proper frequency, and for the appropriate constituents that we originally configured? Further, what program changes need to be made in order to address these questions and future questions about the health of Boulder Creek and its tributaries over the long term? Using this as a barometer, BCWI will continue to adjust the monitoring design as a result of data analysis, outside input, and evolving needs throughout the watershed and over time.

Chemical monitoring is scheduled to continue in 2010. Utilizing Healthy Rivers Fund funding from 2009, BCWI was able to join the highly successful River Watch program run by the Colorado Watershed Assembly. The River Watch program will now enable BCWI Stream Teams to conduct water quality monitoring using State of Colorado accepted equipment and protocols. This will allow for a broader acceptance of data by agencies and other interested parties in the future.

A training for all Stream Team volunteers to instruct them on the use of equipment and protocols via the River Watch program will be conducted in January of 2010. Once each Stream Team practices with and feels comfortable about the use of this equipment and protocols, BCWI staff will then “certify” each team to allow them to begin conducting monthly sampling on their own. Further, River Watch staff will also include two QA/QC events for each Stream Team, one during a “site visit” and again via the mailing of water quality “unknowns” which are to be tested by the volunteers and returned to River Watch. River Watch will then evaluate data from these QA/QC events to further certify each Stream Team during the course of 2010.

River Watch requirements also include physical habitat evaluations and one macroinvertebrate collection at each site for 2010. Macroinvertebrates will be analyzed by an outside laboratory contracted by River Watch. Nutrients will be collected two times during the year and these samples will be analyzed by River Watch staff. Finally, total and dissolved metals samples will also be taken by volunteers and these samples will be analyzed by River Watch staff.

These studies will strengthen the overall program by addressing the physical and biological health of the watershed, and to provide additional baseline information to supplement water chemistry data. By incorporating chemical data from the first and second years of monitoring with physical habitat evaluations and biological data collected in 2010 and beyond, a more comprehensive look at the health of the Boulder Creek watershed will be accomplished.

BCWI will continue to monitor the health of Boulder Creek and its tributaries, as we have in the first two years of the program by analyzing water quality samples for:

- pH
- Nutrients
- Flow
- Dissolved Oxygen
- Temperature
- Conductivity

Additions to the program for 2010 include the following:

- Physical habitat evaluations
- Macroinvertebrate monitoring
- Total and dissolved metals
- Alkalinity
- Hardness

BCWI hopes that the continued monitoring of the chemical, physical, and biological parameters of Boulder Creek and its tributaries will eventually lead state and local governments, as well as individuals to make better-informed decisions about water quality in the watershed. Based upon our work, we strongly encourage the use of Best Management Practices (BMP's), stream restoration projects, other improvements (based upon the need), and regulatory decisions where appropriate. Such committed and comprehensive attention to studying Boulder Creek will help ensure the health and integrity of the Boulder Creek watershed for generations to come.

10. River Stewardship

The mission of the Boulder Creek Watershed Initiative is to "protect and enhance the health of the Boulder Creek watershed by community based stewardship through education, information and action". Engaging the community to become stewards of the Boulder Creek watershed is an integral approach in actively realizing this mission. BCWI, through its water quality monitoring program, strives to foster long-term conservation and stewardship of the Boulder Creek watershed through participation of community members who are intimately involved with their rivers and streams.

Creating a stewardship ethic includes the building of partnerships. These partnerships link government agencies, schools, local businesses, foundations, and the general public, working together to achieve a common goal of river protection and preservation. It is also through these partnerships that BCWI can assure continuation of the water quality program, which will allow ongoing tracking of and response to changes in the water quality of boulder Creek and its tributaries. Finally, working cooperatively with others improves the chances of a grassroots effort toward protection of the Boulder Creek watersheds environmental quality for all current and future inhabitants.

a. Partners

We gratefully acknowledge the following ***project partners*** for the valuable guidance and input they have provided to the BCWI water quality monitoring program:

City of Boulder
City of Louisville
Town of Nederland
Boulder County
Keep It Clean Partnership
United States Environmental Protection Agency
United States Geological Survey
Colorado Department of Public Health and Environment
Colorado Division of Wildlife

b. Supporters

BCWI wishes to thank the following ***supporters*** for their financial and/or in-kind support.

Colorado Watershed Protection Fund (Healthy Rivers Fund)
Patagonia

c. Volunteers

The program is sustained by a dedicated and passionate group of Stream Team ***volunteers*** that we would like to recognize:

Eldora

Bonnie Greenwood
Pam Sherman
Daniel Sherman
Sally Grahn
Noah Greenburg
Tony Farace
Audrey Godell
Fiona Drozda-Samuels
Elizabeth Drozda-Freeman
Barbara Werner

Louisville

Wolfgang Reitz
Bob Rowland
Bob Bennett

Goose Creek

BCWI Staff

Bear Creek

Holly Stevenson
Anna Lieb
Anna Herring
Kathleen Fuller
John Crawford
Corey Wilson
Anna Tribel
Audrey Morris

South Boulder Creek

Brian Vickers
Chris Friedman
Dave Gochis
Matt Kelsch
Brad Thoms
Roy Young

4 Mile Creek

Jonathan Hererra
Gannon Hartnett
Martin Brodsky
Sarah Watson
Cassie Smith

Boulder Creek at CR 20.5

BCWI Staff

11. Stream Team Report Review

Jim Cowart, PE, EnviroGroup Limited

12. References

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Appendix A: Colorado Department of Health Water Quality Control Commission Stream Classifications and Water Quality Standards for Boulder Creek Watershed

REGION: 2 and 3 BASIN: Boulder Creek Stream Segment Description	Desig.	Classifications	NUMERIC STANDARDS					
			PHYSICAL and BIOLOGICAL	INORGANIC mg/l		METALS ug/l		
1. All tributaries to Boulder Creek, including all lakes, reservoirs, and wetlands, within the Indian Peaks Wilderness Area.	OW	Aq Life Cold 1 Recreation 1a Water Supply Agriculture	D.O.=6.0 mg/l D.O.(sp)=7.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	NH3 (ac)=TVS NH3 (ch)=0.02 Cl2 (ac)=0.019 Cl2 (ch)=0.011 CN=0.005	S=0.002 B=0.75 NO2 =0.05 NO3 =10 Cl=250 SO4 =WS	As(ac)=50(Trec) Cd(ac)=TVS(tr) Cd(ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis) Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=10(Trec) Ag(ac)=TVS Ag(ch)=TVS(tr) Zn(ac/ch)=TVS
2. Mainstem of Boulder Creek, including all tributaries, lakes, reservoirs, and wetlands, from the boundary of the Indian Peaks Wilderness Area to a point immediately above the confluence with South Boulder Creek, except for the specific listings in Segment 3 and 12.		Aq Life Cold 1 Recreation 1a Water Supply Agriculture	D.O.=6.0 mg/l D.O.(sp)=7.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	NH3 (ac)=TVS NH3 (ch)=0.02 Cl2 (ac)=0.019 Cl2 (ch)=0.011 CN=0.005	S=0.002 B=0.75 NO2 =0.05 NO3 =10 Cl=250 SO4 =WS	As(ac)=50(Trec) Cd(ac)=TVS(tr) Cd(ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis) Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=10(Trec) Ag(ac)=TVS Ag(ch)=TVS(tr) Zn(ac/ch)=TVS
3. Mainstem of Middle Boulder Creek, including all tributaries, lakes, reservoirs, and wetlands, from the source to the outlet of Barker Reservoir.		Aq Life Cold 1 Recreation 1a Water Supply Agriculture	D.O.=6.0 mg/l D.O.(sp)=7.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	NH3 (ac)=TVS NH3 (ch)=0.02 Cl2 (ac)=0.019 Cl2 (ch)=0.011 CN=0.005	S=0.002 B=0.75 NO2 =0.05 NO3 =10 Cl=250 SO4 =WS	As(ac)=50(Trec) Cd(ac)=TVS(tr) Cd(ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis) Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=10(Trec) Ag(ac)=TVS Ag(ch)=TVS(tr) Zn(ac/ch)=TVS
4a. Mainstem of South Boulder Creek, including all tributaries, lakes, reservoirs, and wetlands, from the source to the outlet of Gross Reservoir.		Aq Life Cold 1 Recreation 1a Water Supply Agriculture	D.O.=6.0 mg/l D.O.(sp)=7.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	NH3 (ac)=TVS NH3 (ch)=0.02 Cl2 (ac)=0.019 Cl2 (ch)=0.011 CN=0.005	S=0.002 B=0.75 NO2 =0.05 NO3 =10 Cl=250 SO4 =WS	As(ac)=50(Trec) Cd(ac)=TVS(tr) Cd(ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis) Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=10(Trec) Ag(ac)=TVS Ag(ch)=TVS(tr) Zn(ac/ch)=TVS
4b. Mainstem of South Boulder Creek, including all tributaries, lakes, and reservoirs, from the outlet of Gross Reservoir to South Boulder Road, except for specific listings in Segments 4c and 4d.		Aq Life Cold 1 Recreation 1a Water Supply Agriculture	D.O.=6.0 mg/l D.O.(sp)=7.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	NH3 (ac)=TVS NH3 (ch)=0.02 Cl2 (ac)=0.019 Cl2 (ch)=0.011 CN=0.005	S=0.002 B=0.75 NO2 =0.05 NO3 =10 Cl=250 SO4 =WS	As(ac)=50(Trec) Cd(ac)=TVS(tr) Cd(ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis) Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=10(Trec) Ag(ac)=TVS Ag(ch)=TVS(tr) Zn(ac/ch)=TVS
4c. Mainstem of Cowdrey Drainage from the source below Cowdrey Reservoir #2 to the Davidson Ditch.	UP	Aq Life Warm 2 Recreation 1a Water Supply Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	CN=0.2 F=2 NO2 =1.0	NO3 =10 Cl=320 SO4 =WS	As(ac)=50 Ba(ac)=1000 Cd(ac)=10 CrIII(ac)=50	Cu(ch)=1000 Fe(ch)=WS(dis) Pb(ac)=50 Mn(ch)=WS(dis)	Se(ch)=10 Ag(ac)=50 Zn(ch)=5000

4d. Mainstem of Cowdrey Drainage from immediately downstream of the Davidson Ditch to the confluence with South Boulder Creek.	UP	Aq Life Warm 2 Recreation 1a Water Supply Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	NH3 (ac)=TVS NH3 (ch)=0.06 Cl2 (ac)=0.019 Cl2 (ch)=0.011 CN=0.003	S=0.002 B=0.75 NO2 =0.5 NO3 =10 Cl=320 SO4 =WS	As(ac)=50(Trec) Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=WS(dis) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis) Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS
5. Mainstem of South Boulder Creek from South Boulder Road to the confluence with Boulder Creek.	UP	Aq Life Warm 1 Recreation 1a Water Supply Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	NH3 (ac)=TVS NH3 (ch)=0.06 Cl2 (ac)=0.019 Cl2 (ch)=0.011 CN=0.005	S=0.002 B=0.75 NO2 =0.5 NO3 =10 Cl=250	As(ac)=50 Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=WS(dis) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis) Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS
6. Mainstem of Coal Creek, including all tributaries, lakes, reservoirs, and wetlands, from the source to highway 93.	UP	Aq Life Cold 2 Recreation 1a Water Supply Agriculture	D.O.=6.0 mg/l D.O.(sp)=7.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	NH3 (ac)=TVS NH3 (ch)=0.02 Cl2 (ac)=0.019 Cl2 (ch)=0.011 CN=0.2	S=0.002 B=0.75 NO2 =0.05 NO3 =10 Cl=250 SO4 =WS	As(ac)=50(Trec) Cd(ac)=TVS(tr) Cd(ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=300(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis) Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac)=TVS Ag(ch)=TVS(tr) Zn(ac/ch)=TVS
7a. Mainstem of Coal Creek from highway 93 to highway 36 (Boulder Turnpike).	UP	Aq Life Warm 1 Recreation 1a Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	NH3 (ac)=TVS NH3 (ch)=0.06 Cl2 (ac)=0.019 Cl2 (ch)=0.011 CN=0.005	S=0.002 B=0.75 NO2 =0.5	As(ch)=100(Trec) Cd(ac/ch)=TVS CrIII(ac/ch)=TVS CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS
7b. Mainstem of Coal Creek from Highway 36 to the confluence with Boulder Creek.	UP	Aq Life Warm 2 Recreation 1a Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	NH3 (ac)=TVS NH3 (ch)=0.06 Cl2 (ac)=0.019 Cl2 (ch)=0.011 CN=0.005	S=0.002 B=0.75 NO2 =0.5	As(ch)=100(Trec) Cd(ac/ch)=TVS CrIII(ac/ch)=TVS CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS
8. All tributaries to South Boulder Creek, including all lakes, reservoirs, and wetlands, from South Boulder Road to the confluence with Boulder Creek and all tributaries to Coal Creek, including all lakes, reservoirs, and wetlands, from Highway 93 to the confluence with Boulder Creek.	UP	Aq Life Warm 2 Recreation 1a Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	NH3 (ac)=TVS NH3 (ch)=0.10 Cl2 (ac)=0.019 Cl2 (ch)=0.011 CN=0.005	S=0.002 B=0.75 NO2 =0.5 NO3 =10 Cl=250 SO4 =WS	As(ch)=50(Trec) Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis) Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS
9. Mainstem of Boulder Creek from a point immediately above the confluence with South Boulder Creek to the confluence with Coal Creek.		Aq Life Warm 1 Recreation 1a Water Supply Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	NH3 (ac)=TVS NH3 (ch)=0.06 Cl2 (ac)=0.019 Cl2 (ch)=0.011 CN=0.005	S=0.002 B=0.75 NO2 =0.5 NO3 =10 Cl=250	As(ac)=50(Trec) Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS

					SO4 =WS		Hg(ch)=0.01(Tot)	
10. Mainstem of Boulder Creek from the confluence with Coal Creek to the confluence with St. Vrain Creek.	UP	Aq Life Warm 1 Recreation 1a Water Supply Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	NH3 (ac)=TVS NH3 (ch)=0.06 Cl2 (ac)=0.019 Cl2 (ch)=0.011 CN=0.005	S=0.002 B=0.75 NO2 =0.5 NO3 =10 Cl=250 SO4 =WS	As(ac)=50(Trec) Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis) Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS
11. All tributaries to Boulder Creek from a point immediately above the confluence with South Boulder Creek to the confluence with St. Vrain Creek, except for specific listings in Segments 5 and 7.	UP	Aq Life Warm 2 Recreation 1a Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	NH3 (ac)=TVS NH3 (ch)=0.10 Cl2 (ac)=0.019 Cl2 (ch)=0.011 CN=0.005	S=0.002 B=0.75 NO2 =0.5 NO3 =10 Cl=250 SO4 =WS	As(ac)=50(Trec) Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis) Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS
12. Boulder Reservoir and Coot Lake.		Aq Life Warm 1 Recreation 1a Water Supply Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=200/100ml E.Coli=126/100ml	NH3 (ac)=TVS NH3 (ch)=0.06 Cl2 (ac)=0.019 Cl2 (ch)=0.011 CN=0.005	S=0.002 B=0.75 NO2 =0.5 NO3 =10 Cl=250 SO4 =WS	As(ac)=50(Trec) Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis) Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS

Miscellaneous equipment needs 04/07/08

Company	Contact	Phone #	What	Quantity	Product #	Cost	Total Cost
Chemetrics	Holly	800-356-3072	V 2000 Photometer	3	V-2000	$920.00	$2,760.00
			Phosphat ampuoles	3	K-8513	$49.00	$147.00
			Nitrate ampuoles	3	K-6903	$67.40	$202.20
			DO ampuoles	3	K-7513	$51.40	$154.20
			Carrying case	3			
Oakton	Loretta	800-545-0530 #5122	Acorn pH 5 meter	3ea	WD-35613-70	$299.00	$899.97
Extech	Frank	352-683-9095	Exstick Conductivity Meter	3ea	EC410	119.99	$359.97
VWR		800-865-5220	16 oz wide mouth bottle	1 pack-12	16126-100	$85.57	$85.57
Scientific			250 ml wash bottle	1 pack-4	16651-573	$35.72	$35.72
			1000 ml wide mouth	1 pack-6	16121-081	$88.07	$88.07
Fisher	Misc.	800-766-7000	Field Thermometer	3ea	15-021-B	$15	$45.00
Scientific			Latex gloves	1 bx-M	19121-915-B	$13.50	$13.50
				1 bx-L	19121-915-C	$13.50	$13.50
			Kemwipes	3ea	066-66-A	$5.50	$16.50
Dicks Sporting			Waders	11		$20	$220.00
Goods							
McGuckin	Randy Dilkes	303-443-1822					
Hardware			Clippers	3ea		$2.69	$8.07
			AA Batteries	12ea		$5.99	$17.19
			pocket protectors	3ea		$0.59	$1.77
			Stop watches	3ea		$8.99	$26.97
			Large tote	3ea		$8.99	$51.27
			Carry tote	3ea		$11.99	$32.37
			Blue gloves	4ea		$5.99	$21.56
			Farm gloves	3ea		$7.00	$21.57
			Alluminum yardstick	3 ea		$6.99	$18.87
			Safety glasses	3ea		$6.99	$20.97

Reel tape	3ea	$19.99	$59.97
Clipboard	3ea	$1.89	$5.67
Pencils	1ea	$1.69	$1.69
Pens	2ea	$2.99	$5.98
Calculators	3ea	$6.99	$20.97
Sharpies	3ea	$1.25	$3.75
Memo pads	3ea	$0.89	$2.67
Clippers	3ea	$2.69	$8.07
Air thermometers	3ea	$2.99	$8.97
Screwdrivers	3ea	$3.49	$10.47

BCWI Ac #	BCWI Ac #
1357785	3045052

Appendix B: Water Quality Equipment						
Company	**Contact**	**Phone #**	**What**	**Quantity**	**Product #**	
Chemetrics	Holly	800-356-3072	V 2000 Photometer	3	V-2000	
			Phosphat ampuoles	3	K-8513	
			Nitrate ampuoles	3	K-6903	
			DO ampuoles	3	K-7513	
			Carrying case	3		
Oakton	Loretta	800-545-0530 #5122	Acorn pH 5 meter	3ea	WD-35613-70	
Extech	Frank	352-683-9095	Exstick Conductivity Meter	3ea	EC410	
VWR		800-865-5220	16 oz wide mouth bottle	1 pack-12	16126-100	
Scientific			250 ml wash bottle	1 pack-4	16651-573	
			1000 ml wide mouth	1 pack-6	16121-081	
Fisher	Misc.	800-766-7000	Field Thermometer	3ea	15-021-B	
Scientific			Latex gloves	1 bx-M	19121-915-B	
				1 bx-L	19121-915-C	
			Kemwipes	3ea	066-66-A	
Dicks Sporting			Waders	11		
Goods						
McGuckin	Randy Dilkes	303-443-1822				
Hardware			Clippers	3ea	Reel tape	3ea
			AA Batteries	12ea	Clipboard	3ea
			pocket protectors	3ea	Pencils	1ea
			Stop watches	3ea	Pens	2ea
			Large tote	3ea	Calculators	3ea
			Carry tote	3ea	Sharpies	3ea
			Blue gloves	4ea	Memo pads	3ea
			Farm gloves	3ea	Clippers	3ea
			Alluminum yardstick	3 ea	Air thermometers	3ea
			Safety glasses	3ea	Screwdrivers	3ea

Appendix B: Water Quality Equipment

Company	Contact	Phone #	What	Quantity	Product #	
Chemetrics	Holly	800-356-3072	V 2000 Photometer	3	V-2000	
			Phosphat ampuoles	3	K-8513	
			Nitrate ampuoles	3	K-6903	
			DO ampuoles	3	K-7513	
			Carrying case	3		
Oakton	Loretta	800-545-0530 #5122	Acorn pH 5 meter	3ea	WD-35613-70	
Extech	Frank	352-683-9095	Exstick Conductivity Meter	3ea	EC410	
VWR		800-865-5220	16 oz wide mouth bottle	1 pack-12	16126-100	
Scientific			250 ml wash bottle	1 pack-4	16651-573	
			1000 ml wide mouth	1 pack-6	16121-081	
Fisher	Misc.	800-766-7000	Field Thermometer	3ea	15-021-B	
Scientific			Latex gloves	1 bx-M	19121-915-B	
				1 bx-L	19121-915-C	
			Kemwipes	3ea	066-66-A	
Dicks Sporting			Waders	11		
Goods						
McGuckin	Randy Dilkes	303-443-1822				
Hardware			Clippers	3ea	Reel tape	3ea
			AA Batteries	12ea	Clipboard	3ea
			pocket protectors	3ea	Pencils	1ea
			Stop watches	3ea	Pens	2ea
			Large tote	3ea	Calculators	3ea
			Carry tote	3ea	Sharpies	3ea
			Blue gloves	4ea	Memo pads	3ea
			Farm gloves	3ea	Clippers	3ea
			Alluminum yardstick	3 ea	Air thermometers	3ea
			Safety glasses	3ea	Screwdrivers	3ea

StreamTeam	Team Leader	# of partic	Stream Name	City
Eldora	Bonnie Greenwoo	6	Middle Boulder Creek	Eldora
Eldora	Bonnie Greenwoo	6	Middle Boulder Creek	Eldora
Eldora	Bonnie Greenwoo	6	Middle Boulder Creek	Eldora
Eldora	Bonnie Greenwoo	6	Middle Boulder Creek	Eldora
Eldora	Bonnie Greenwoo	3	Middle Boulder Creek	Eldora
Eldora	Bonnie Greenwoo	3	Middle Boulder Creek	Eldora
Patagonia	by Hempel	1	4 Mile Creek	Boulder
Patagonia	by Hempel	1	4 Mile Creek	Boulder
Patagonia	by Hempel	2	Bear Creek	Boulder
Patagonia	Anna Lieb	4	Bear Creek	Boulder
Patagonia	Jon Herrera	4	4 Mile Creek	Boulder
Patagonia	Jon Herrera	5	4 Mile Creek	Boulder
Patagonia	Jon Herrera	4	4 Mile Creek	Boulder
Patagonia	Jon Herrera	4	4 Mile Creek	Boulder
Patagonia	**Jon Herrera**	**4**	**4 Mile Creek**	**Boulder**
Patagonia	Jon Herrera	3	4 Mile Creek	Boulder
Louisville	by Hempel	1	Coal Creek	Louisville
Louisville	Wolfgang Reitz	3	Coal Creek	Louisville
Louisville	by Hempel	1	4 Mile Creek	Louisville
Louisville	Bob Rowland	3	Coal Creek	Louisville
Louisville	Bob Rowland	3	Coal Creek	Louisville
Louisville	Bob Rowland	3	Coal Creek	Louisville
Louisville	Bob Rowland	3	Coal Creek	Louisville
Louisville	Bob Rowland	3	Coal Creek	Louisville
Louisville	Bob Rowland	3	Coal Creek	Louisville
Louisville	Bob Rowland	3	Coal Creek	Louisville
Louisville	Bob Rowland	3	Coal Creek	Louisville
South Boulder Creek	Brian Vickers	2	South Boulder Creek	Boulder
South Boulder Creek	Brian Vickers	4	South Boulder Creek	Boulder
South Boulder Creek	Brian Vickers		South Boulder Creek	Boulder
South Boulder Creek	Brian Vickers		South Boulder Creek	Boulder
South Boulder Creek	Brian Vickers		South Boulder Creek	Boulder
South Boulder Creek	Brian Vickers		South Boulder Creek	Boulder
South Boulder Creek	Brian Vickers		South Boulder Creek	Boulder
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South Boulder Creek	Brian Vickers		South Boulder Creek	Boulder
South Boulder Creek	Brian Vickers		South Boulder Creek	Boulder
South Boulder Creek	Brian Vickers		South Boulder Creek	Boulder
South Boulder Creek	Brian Vickers		South Boulder Creek	Boulder
CU Wild	by Hempel	1	Bear Creek	Boulder

CU Wild	Anna Lieb	4	Bear Creek	Boulder
CU Wild	Anna Lieb	2	Bear Creek	Boulder
CU Wild	by Hempel	1	Bear Creek	Boulder
CU Wild	by Hempel	2	Bear Creek	Boulder
CU Wild	by Hempel	1	Bear Creek	Boulder
CU Wild	by Crawford	2	Bear Creek	Boulder
CU Wild	Anna Lieb	3	Bear Creek	Boulder
CU Wild	Anna Lieb	3	Bear Creek	Boulder
CU Wild	Anna Lieb	3	Bear Creek	Boulder
North Boulder	by Hempel	2	Goose Creek	Boulder
North Boulder	by Hempel	3	Goose Creek	Boulder
North Boulder	by Hempel	2	Goose Creek	Boulder
North Boulder	by Hempel	1	Goose Creek	Boulder
North Boulder	by Hempel	1	Goose Creek	Boulder
North Boulder	by Hempel	2	Goose Creek	Boulder
North Boulder	by Hempel	1	Goose Creek	Boulder
North Boulder	by Crawford	2	Goose Creek	Boulder
North Boulder	by Hempel	1	Goose Creek	Boulder
North Boulder	by Hempel	1	Goose Creek	Boulder
North Boulder	by Hempel	1	Goose Creek	Boulder
North Boulder	by Hempel	1	Goose Creek	Boulder
Longmont	by Hempel	1	Boulder Creek	Longmont
Longmont	by Hempel	1	Boulder Creek	Longmont
Longmont	by Hempel	1	Boulder Creek	Longmont
Longmont	by Hempel	1	Boulder Creek	Longmont
Longmont	by Hempel	1	Boulder Creek	Longmont
Longmont	by Hempel	1	Boulder Creek	Longmont
Longmont	by Crawford	2	Boulder Creek	Longmont
Longmont	by Hempel	1	Boulder Creek	Longmont
Longmont	by Hempel	1	Boulder Creek	Longmont
Longmont	by Hempel	1	Boulder Creek	Longmont
Longmont	by Hempel	1	Boulder Creek	Longmont

Location	Date	Time (24 hr)	Air (°C)	Weather Conditions	Flow Rate (cfs)	Dissolved Oxygen (ppm)
Marysville Bridge	3/1	13:30	12C	sunny, windy	6.19	9.41
Marysville Bridge	5/3	15:30	13C	sunny, windy	93.5	8.69
Marysville Bridge	7/5	3:30		partly cloudy	248	8.13
Marysville Bridge	8/9	14:53	22C	sunny	47.4	7.60
Marysville Bridge	10/18	13:15	20C	sunny, warm	37.5	8.72
Marysville Bridge	11/7	13:00	13C	sunny	21.9	9.18
at confl. w/ BC	1/5	9:45	6C	overcast, cold	<5, ice	9.63
at confl. w/ BC	2/4	10:35	23 C	sunny, warm	<5, min	9.99
at confl. w/ BC	3/6	10:40	0 C	sunny, breezy	<5, min	9.10
at arapahoe/foothills	4/4	11:00		cold, fresh snov	9.3	7.48
at confl. w/ BC	5/3	8:15	9C	cloudy	<5, min	8.44
at confl. w/ BC	6/7					8.89
at confl. w/ BC	7/5	8:07			8.5	7.43
at confl. w/ BC	8/2	7:40	10C	sunny	24	7.81
at confl. w/ BC	**10/4**					
at confl. w/ BC	11/8	8:45	6C		35.5	9.70
before golf course	1/3	11:00	0 C	loudy, light sno	<5, min	6.26
before golf course	2/8	10:30	16 C	overcast	<5, min	6.64
before golf course	3/6	7:45	8 C	sunny, cool	<5, min	4.98
before golf course	4/5	10:45		sunny, cool	<5, min	NA
before golf course	5/3	11:00	13 C	partly sunny	<5, min	9.65
before golf course	6/7	10:45	19C	cloudy	11.0	7.60
before golf course	7/12	17:30	27C		<5, min	6.07
before golf course	8/2	10:45	28C	sunny	<5, min	7.67
before golf course	9/13	10:30	18C	sunny	<5, min	4.57
before golf course	10/4	11:00	20C	overcast	<5, min	5.90
before golf course	11/8	10:30	12C	partly cloudy	<5, min	6.63
bobolink trailhead	1/10	9:00	0 C	all cloudy	<5, min	7.69
bobolink trailhead	2/7	9:10	45 C	clear, sunny	<5, min	8.45
bobolink trailhead	3/7	9:00		partly cloudy	<5, min	8.20
bobolink trailhead	4/11	9:00	5C	cloudy	<5, min	9.10
bobolink trailhead	5/7	18:00		warm	9.3	6.70
bobolink trailhead	6/4				91	9.00
bobolink trailhead	7/7				11	7.39
bobolink trailhead	8/11				12	7.6
bobolink trailhead	9/15				7.8	7.90
bobolink trailhead	10/16	17:00	12C	partly cloudy	7.4	7.50
bobolink trailhead	11/21	9:00	6C	partly cloudy	<5, min	10.50
bobolink trailhead	12/12	9:15	9C	partly cloudy	<5, min	9.90
at confl. w/ BC	1/5	11:15	4C	cloudy, cold	<5, min	8.14

at arapahoe/foothills	2/7	9:20	13 C	sunny	<5, min	7.17
at arapahoe/foothills	3/7	9:15	2C	sunny	<5, min	6.74
at arapahoe/foothills	5/2	9:30		overcast, light ra	6.1	7.28
at arapahoe/foothills	6/6	10:00	21C	sunny	< 5, min	6.97
at arapahoe/foothills	7/3	9:00		warm, overcast	<5, min	5.19
at arapahoe/foothills	8/8	15:00				7.76
at arapahoe/foothills	9/6	9:20	32C	ınny, slght clou	<5, min	5.91
at arapahoe/foothills	10/3	9:20		sunny, warm	<5, min	7.94
at arapahoe/foothills	11/7	9:00		sunny, warm	<5, min	6.37
mapleton & 30th	1/5	13:15	0C	cloudy, cold	<5, min	9.46
mapleton & 30th	2/7	12:00	11C	sunny	<5, min	9.85
mapleton & 30th	3/6	12:15		sunny	<5, min	9.56
mapleton & 30th	4/1	12:00		overcast, cool	2.8	8.88
mapleton & 30th	5/7	12:40		sunny, warm	<5, min	7.88
mapleton & 30th	6/6	11:30	22C	sunny	<5, min	8.16
mapleton & 30th	7/3	11:00		warm, sunny	<5, min	7.03
mapleton & 30th	8/8	16:00			<5, min	7.26
mapleton & 30th	9/7	10:40		sunny, warm	<5, min	7.32
mapleton & 30th	10/3	11:30		sunny, warm	<5, min	8.71
mapleton & 30th	11/6	13:45		sunny, warm	<5, min	8.17
mapleton & 30th	12/5	11:40		sunny, cold	<5, min	12.30
Bld Cr at WCR20.5	1/6	10:45	4C	sunny, cool	53	11.23
Bld Cr at WCR20.5	2/4	13:25	27 C	sunny, warm	47	11.93
Bld Cr at WCR20.5	3/5	12:24	30 C	sunny	32	13.25
Bld Cr at WCR20.5	4/4	13:00		cold, windy	33	11.32
Bld Cr at WCR20.5	5/2	11:25		overcast, cool	33	8.52
Bld Cr at WCR20.5	7/3	12:40		sunny, warm	140	8.11
Bld Cr at WCR20.5	8/8	17:00			5.9	9.42
Bld Cr at WCR20.5	9/7	12:00		sunny, warm	6.1	7.32
Bld Cr at WCR20.5	10/3	12:55		sunny, warm	15	11.52
Bld Cr at WCR20.5	11/6	12:10		sunny, warm	62	11.74
Bld Cr at WCR20.5	12/5	13:00		sunny, cold	51	13.10

Nitrate (.2 - 1.5 ppm)	Phosphate (.3 - 8.0 ppm)	pH	Water Temp (°C)	Conductivity	Comments
0.17	0.03	6.95	2C	62	
0.11	0	7.09	5C	54	
0.12	0.08	6.82	10C	37	
0.13	0.07	6.65	13C	31	
0.12	0.00	6.80		28	
0.17	0.02	6.40		45	
0.27	0	7.22	2C	611	
0.15	0.07	7.55	-3 C	336	
0.14	0.03	7.65	-2 C	300	
0.37	0.25	7.71	6C	1169	
0.16	0.03	8.03	2C	185	
0.11	0.01	7.50	2C	157	
0.07	0.01	7.77	3C	179	
0.12	0.12	8.37	19C	252	
10.00	0.00	8.74	0C	200	
1.06	0.02	6.99	2C	1420	sample taken approx 100 n
1.53	0.06	7.00	4C	107	sample taken approx 125 n
1.30	0.02	6.86	28 C	3070	standing water
0.63	<.3	7.37	0	1369	little h2o movement for fl
0.30	0	7.39	10C	545	
0.13	0.09	7.27	12C	255	
0.64	0.13	7.49	18C	80	
0.19	0.18	7.38	14C	277	
0.28	0.14	7.32	8C	551	
0.40	0.06	7.46	2C	805	
0.37	0.75	7.09	2C	841	
0.16	0	6.86	NA	349	
0.13	0	7.40	4C	249	water stagnant
< .2	< .3	7.04		279	
< .2	< .3	7.28	7C	281	
<.2	<.3	7.48	2C	169	
0.23	<.3	6.86	17C	79	
<.2	<.3	8.1	20C	96	
<.2	<.3	7.13	19C	67	
<.2	<.3	6.83	20C	90	
<.2	<.3	6.96	13C	228	
<.2	<.3	7.43	3C	NA	
<.2	<.3	7.18	1C	NA	
0.08	0	7.22	3C	1178	

0.06	0.61	7.68	2C	1206	
0.48	0.00	7.55	5C	1255	
0.24	<.3	7.50	10C	581	
0.16	0.08	7.25	16C	451	
0.10	0.18	7.20	16C	501	
<.2	0.72	7.40	20C	374	beaver dam impeding flow
0.11	0.18	7.26	15C	481	
0.17	0.04	8.31	2C	335	
0.13	0.13	7.30	5C	808	
over range	0.03	7.19	0C	1043	
2.67	0	7.99	2C	959	nitrate sample diluted 1 pa
1.56	0.03	8.09	4 C	941	
1.95	0.03	7.94	4C	1130	
1.20	0.12	8.01	12C	845	
1.00	0.17	7.85	15C	608	
0.51	0.21	7.60	16C	488	
0.30	0.14	7.60	21C	432	
3.72	0.14	7.97	15C	1010	
1.68	0.05	8.11	9C	885	
1.44	0.19	7.90	11C	967	
0.75	NA	8.10	8C	1028	
over range	2.16	8.30	3C	785	
over range	5.94	7.85	2C	768	
over range	6.70	8.76	10 C	9	
2.16	2.36	8.23	3	1106	
3.69	2.00	7.58	11C	558	
0.63	1.10	7.81	18C	352	
0.97	1.39	8.85		809	
0.24	0.80	8.10	18C	1105	
1.62	1.35	8.66	9C	759	
3.21	2.84	8.74	9C	750	
overrange	4.00	8.52	-1	962	

neters above customary sampling station
neters above customary sampling station

ow, enough for sample

rt sample:2 parts di water

StreamTeam	Team Leader	# of partic	Stream Name	City	Location	Date	Time (24 hr)	Air (°C)
Louisville	by Hempel	1	Coal Creek	Louisville	before golf course	1/3	11:00	0 C
Patagonia	by Hempel	1	4 Mile Creek	Boulder	at confl. w/ BC	1/5	9:45	6C
CU Wild	by Hempel	1	Bear Creek	Boulder	at confl. w/ BC	1/5	11:15	4C
North Boulder	by Hempel	2	Goose Creek	Boulder	mapleton & 30th	1/5	13:15	0C
Longmont	by Hempel	1	Boulder Creek	Longmont	Bld Cr at WCR20.5	1/6	10:45	4C
South Boulder C	Brian Vickers	2	South Boulder Creel	Boulder	bobolink trailhead	1/10	9:00	0 C
Patagonia	by Hempel	1	4 Mile Creek	Boulder	at confl. w/ BC	2/4	10:35	23 C
Longmont	by Hempel	1	Boulder Creek	Longmont	Bld Cr at WCR20.5	2/4	13:25	27 C
South Boulder C	Brian Vickers	4	South Boulder Creel	Boulder	bobolink trailhead	2/7	9:10	45 C
CU Wild	Anna Lieb	4	Bear Creek	Boulder	at arapahoe/foothills	2/7	9:20	13 C
North Boulder	by Hempel	3	Goose Creek	Boulder	mapleton & 30th	2/7	12:00	11C
Louisville	Wolfgang Reitz	3	Coal Creek	Louisville	before golf course	2/8	10:30	16 C
Eldora	Bonnie Greenwood	6	Middle Boulder Cree	Eldora	Marysville Bridge	3/1	13:30	12C
Longmont	by Hempel	1	Boulder Creek	Longmont	Bld Cr at WCR20.5	3/5	12:24	30 C
Louisville	by Hempel	1	4 Mile Creek	Louisville	before golf course	3/6	7:45	8 C
Patagonia	by Hempel	2	Bear Creek	Boulder	at confl. w/ BC	3/6	10:40	0 C
North Boulder	by Hempel	2	Goose Creek	Boulder	mapleton & 30th	3/6	12:15	
CU Wild	Anna Lieb	2	Bear Creek	Boulder	at arapahoe/foothills	3/7	9:15	2C
South Boulder C	Brian Vickers		South Boulder Creel	Boulder	bobolink trailhead	3/7	9:00	
North Boulder	by Hempel	1	Goose Creek	Boulder	mapleton & 30th	4/1	12:00	
Patagonia	Anna Lieb	4	Bear Creek	Boulder	at arapahoe/foothills	4/4	11:00	
Longmont	by Hempel	1	Boulder Creek	Longmont	Bld Cr at WCR20.5	4/4	13:00	
4 Mile Creek	Jon Herrera	4	4 Mile Creek	Boulder	at confl. w/ BC	4/5	8:18	
Louisville	Bob Rowland	3	Coal Creek	Louisville	before golf course	4/5	10:45	
South Boulder C	Brian Vickers		South Boulder Creel	Boulder	bobolink trailhead	4/11	9:00	5C
CU Wild	by Hempel	1	Bear Creek	Boulder	at arapahoe/foothills	5/2	9:30	
Longmont	by Hempel	1	Boulder Creek	Longmont	Bld Cr at WCR20.5	5/2	11:25	
Patagonia	Jon Herrera	4	4 Mile Creek	Boulder	at confl. w/ BC	5/3	8:15	9C
Louisville	Bob Rowland	3	Coal Creek	Louisville	before golf course	5/3	11:00	13 C
Eldora	Bonnie Greenwood	6	Middle Boulder Cree	Eldora	Marysville Bridge	5/3	15:30	13C

North Boulder	by Hempel	1	Goose Creek	Boulder	mapleton & 30th	5/7	12:40	
South Boulder C	Brian Vickers		South Boulder Creel	Boulder	bobolink trailhead	5/7	18:00	
South Boulder C	Brian Vickers		South Boulder Creel	Boulder	bobolink trailhead	6/4		
CU Wild	by Hempel	2	Bear Creek	Boulder	at arapahoe/foothills	6/6	10:00	21C
North Boulder	by Hempel	2	Goose Creek	Boulder	mapleton & 30th	6/6	11:30	22C
Louisville	Bob Rowland	3	Coal Creek	Louisville	before golf course	6/7	10:45	19C
Patagonia	Jon Herrera	5	4 Mile Creek	Boulder	at confl. w/ BC	6/7		
CU Wild	by Hempel	1	Bear Creek	Boulder	at arapahoe/foothills	7/3	9:00	
North Boulder	by Hempel	1	Goose Creek	Boulder	mapleton & 30th	7/3	11:00	
Longmont	by Hempel	1	Boulder Creek	Longmont	Bld Cr at WCR20.5	7/3	12:40	
Patagonia	Jon Herrera	4	4 Mile Creek	Boulder	at confl. w/ BC	7/5	8:07	
Eldora	Bonnie Greenwood	6	Middle Boulder Cree	Eldora	Marysville Bridge	7/5	3:30	
outh Boulder Cre	Brian Vickers		South Boulder Creek	Boulder	bobolink trailhead	7/7		
Louisville	Bob Rowland	3	Coal Creek	Louisville	before golf course	7/12	17:30	27C
Patagonia	Jon Herrera	4	4 Mile Creek	Boulder	at confl. w/ BC	8/2	7:40	10C
Louisville	Bob Rowland	3	Coal Creek	Louisville	before golf course	8/2	10:45	28C
CU Wild	by Crawford	2	Bear Creek	Boulder	at arapahoe/foothills	8/8	15:00	
North Boulder	by Crawford	2	Goose Creek	Boulder	mapleton & 30th	8/8	16:00	
Longmont	by Crawford	2	Boulder Creek	Longmont	Bld Cr at WCR20.5	8/8	17:00	
Eldora	Bonnie Greenwood	6	Middle Boulder Cree	Eldora	Marysville Bridge	8/9	14:53	22C
South Boulder C	Brian Vickers		South Boulder Creel	Boulder	bobolink trailhead	8/11		
CU Wild	Anna Lieb	3	Bear Creek	Boulder	at arapahoe/foothills	9/6	9:20	32C
North Boulder	by Hempel	1	Goose Creek	Boulder	mapleton & 30th	9/7	10:40	
Longmont	by Hempel	1	Boulder Creek	Longmont	Bld Cr at WCR20.5	9/7	12:00	
Louisville	Bob Rowland	3	Coal Creek	Louisville	before golf course	9/13	10:30	18C
South Boulder C	Brian Vickers		South Boulder Creel	Boulder	bobolink trailhead	9/15		
CU Wild	Anna Lieb	3	Bear Creek	Boulder	at arapahoe/foothills	10/3	9:20	
North Boulder	by Hempel	1	Goose Creek	Boulder	mapleton & 30th	10/3	11:30	
Longmont	by Hempel	1	Boulder Creek	Longmont	Bld Cr at WCR20.5	10/3	12:55	
Patagonia	**Jon Herrera**	**4**	**4 Mile Creek**	**Boulder**	**at confl. w/ BC**	**10/4**		
Louisville	Bob Rowland	3	Coal Creek	Louisville	before golf course	10/4	11:00	20C
South Boulder C	Brian Vickers		South Boulder Creel	Boulder	bobolink trailhead	10/16	17:00	12C

Eldora	Bonnie Greenwood	3	Middle Boulder Cree	Eldora	Marysville Bridge	10/18	13:15	20C
North Boulder	by Hempel	1	Goose Creek	Boulder	mapleton & 30th	11/6	13:45	
Longmont	by Hempel	1	Boulder Creek	Longmont	Bld Cr at WCR20.5	11/6	12:10	
CU Wild	Anna Lieb	3	Bear Creek	Boulder	at arapahoe/foothills	11/7	9:00	
Patagonia	Jon Herrera	3	4 Mile Creek	Boulder	at confl. w/ BC	11/8	8:45	6C
Louisville	Bob Rowland	3	Coal Creek	Louisville	before golf course	11/8	10:30	12C
Eldora	Bonnie Greenwood	3	Middle Boulder Cree	Eldora	Marysville Bridge	11/7	13:00	13C
South Boulder C	Brian Vickers		South Boulder Creel	Boulder	bobolink trailhead	11/21	9:00	6C
North Boulder	by Hempel	1	Goose Creek	Boulder	mapleton & 30th	12/5	11:40	
Longmont	by Hempel	1	Boulder Creek	Longmont	Bld Cr at WCR20.5	12/5	13:00	
South Boulder C	Brian Vickers		South Boulder Creel	Boulder	bobolink trailhead	12/12	9:15	9C

Weather Conditions	Flow Rate (cfs)	Dissolved Oxygen (ppm)	Nitrate (.2 - 1.5 ppm)	Phosphate (.3 - 8.0 ppm)	pH	Water Temp (°C)	Conductivity	DO (% sat)
cloudy, light snow	<5, min	6.26	1.06	0.02	6.99	2C	1420	
overcast, cold	<5, ice	9.63	0.27	0	7.22	2C	611	
cloudy, cold	<5, min	8.14	0.08	0	7.22	3C	1178	
cloudy, cold	<5, min	9.46	over range	0.03	7.19	0C	1043	
sunny, cool	53	11.23	over range	2.16	8.30	3C	785	
all cloudy	<5, min	7.69	0.16	0	6.86	NA	349	
sunny, warm	<5, min	9.99	0.15	0.07	7.55	-3 C	336	
sunny, warm	47	11.93	over range	5.94	7.85	2C	768	
clear, sunny	<5, min	8.45	0.13	0	7.40	4C	249	
sunny	<5, min	7.17	0.06	0.61	7.68	2C	1206	
sunny	<5, min	9.85	2.67	0	7.99	2C	959	
overcast	<5, min	6.64	1.53	0.06	7.00	4C	107	
sunny, windy	6.19	9.41	0.17	0.03	6.95	2C	62	
sunny	32	13.25	over range	6.70	8.76	10 C	9	
sunny, cool	<5, min	4.98	1.30	0.02	6.86	28 C	3070	
sunny, breezy	<5, min	9.10	0.14	0.03	7.65	-2 C	300	
sunny	<5, min	9.56	1.56	0.03	8.09	4 C	941	
sunny	<5, min	6.74	0.48	0.00	7.55	5C	1255	
partly cloudy	<5, min	8.20	< .2	< .3	7.04		279	
overcast, cool	2.8	8.88	1.95	0.03	7.94	4C	1130	
cold, fresh snow	9.3	7.48	0.37	0.25	7.71	6C	1169	
cold, windy	33	11.32	2.16	2.36	8.23	3	1106	
cold	<5, min	NA	0.15	<.3	8.53	-3	340	
sunny, cool	<5, min	NA	0.63	<.3	7.37	0	1369	
cloudy	<5, min	9.10	< .2	< .3	7.28	7C	281	
overcast, light rain	6.1	7.28	0.24	<.3	7.50	10C	581	
overcast, cool	33	8.52	3.69	2.00	7.58	11C	558	
cloudy	<5, min	8.44	0.16	0.03	8.03	2C	185	
partly sunny	<5, min	9.65	0.30	0	7.39	10C	545	
sunny, windy	93.5	8.69	0.11	0	7.09	5C	54	

sunny, warm	<5, min	7.88	1.20	0.12	8.01	12C	845
warm	9.3	6.70	<.2	<.3	7.48	2C	169
	91	9.00	0.23	<.3	6.86	17C	79
sunny	< 5, min	6.97	0.16	0.08	7.25	16C	451
sunny	<5, min	8.16	1.00	0.17	7.85	15C	608
cloudy	11.0	7.60	0.13	0.09	7.27	12C	255
		8.89	0.11	0.01	7.50	2C	157
warm, overcast	<5, min	5.19	0.10	0.18	7.20	16C	501
warm, sunny	<5, min	7.03	0.51	0.21	7.60	16C	488
sunny, warm	140	8.11	0.63	1.10	7.81	18C	352
	8.5	7.43	0.07	0.01	7.77	3C	179
partly cloudy	248	8.13	0.12	0.08	6.82	10C	37
	11	7.39	<.2	<.3	8.1	20C	96
	<5, min	6.07	0.64	0.13	7.49	18C	80
sunny	24	7.81	0.12	0.12	8.37	19C	252
sunny	<5, min	7.67	0.19	0.18	7.38	14C	277
		7.76	<.2	0.72	7.40	20C	374
	<5, min	7.26	0.30	0.14	7.60	21C	432
	5.9	9.42	0.97	1.39	8.85		809
sunny	47.4	7.60	0.13	0.07	6.65	13C	31
	12	7.6	<.2	<.3	7.13	19C	67
sunny, slght cloudy	<5, min	5.91	0.11	0.18	7.26	15C	481
sunny, warm	<5, min	7.32	3.72	0.14	7.97	15C	1010
sunny, warm	6.1	7.32	0.24	0.80	8.10	18C	1105
sunny	<5, min	4.57	0.28	0.14	7.32	8C	551
	7.8	7.90	<.2	<.3	6.83	20C	90
sunny, warm	<5, min	7.94	0.17	0.04	8.31	2C	335
sunny, warm	<5, min	8.71	1.68	0.05	8.11	9C	885
sunny, warm	15	11.52	1.62	1.35	8.66	9C	759
overcast	<5, min	5.90	0.40	0.06	7.46	2C	805
partly cloudy	7.4	7.50	<.2	<.3	6.96	13C	228

sunny, warm	37.5	8.72	0.12	0.00	6.80		28
sunny, warm	<5, min	8.17	1.44	0.19	7.90	11C	967
sunny, warm	62	11.74	3.21	2.84	8.74	9C	750
sunny, warm	<5, min	6.37	0.13	0.13	7.30	5C	808
	35.5	9.70	10.00	0.00	8.74	0C	200
partly cloudy	<5, min	6.63	0.37	0.75	7.09	2C	841
sunny	21.9	9.18	0.17	0.02	6.40		45
partly cloudy	<5, min	10.50	<.2	<.3	7.43	3C	NA
sunny, cold	<5, min	12.30	0.75	NA	8.10	8C	1028
sunny, cold	51	13.10	overrange	4.00	8.52	-1	962
partly cloudy	<5, min	9.90	<.2	<.3	7.18	1C	NA

Comments

sample taken approx 100 meters above customary sampling station

water stagnant

nitrate sample diluted 1 part sample:2 parts di water
sample taken approx 125 meters above customary sampling station

standing water

little h2o movement for flow, enough for sample beaver dam impeding flow

Water Quality Monitoring

Water Quality Testing Procedures

Discharge, Dissolved Oxygen (Oxygen 2), Nitrate, Phosphate, pH, Temperature, Conductivity

Materials provided:

- Clear container for storage of all Stream Team materials
- Rubbermaid carrying case for sample bottles
- Water Quality Monitoring Field Data Sheet
- Blue folder: Information and Procedures
- **V - 2000 Photometer** (in blue hard case)
- Water Quality parameter Test Kits including laminated instructions (also in blue hard case)
    - **Nitrate** Test Kit
    - **Phosphate 2** Test Kit
    - **Oxygen 2** Test Kit
- **Oakton pH 5 meter in black case** pH and temperature
- **Extech Exstik II** Conductivity meter (also stored in the pH meter's case)
- Safety goggles (3)
- Gloves
- Reel tape measure
- Stakes (2)
- Calculator
- Stop watch
- Thermometer (in degrees Celsius)
- Yard stick (steel)
- Kem-wipes
- Deionized water (in squirt bottle)
- Deionized water (extra bottle)
- pH buffer solutions (7 = yellow, 10 = blue)
- Conductivity calibration solution: 1413 μS/cm conductivity/TDS standard solution
- Used ampoule and waste water container
- Sample Bottle: **Dissolved Oxygen** , **Phosphate and Nitrate**
- Sample Bottle: **pH and conductivity**
- 50/50 alcohol/deionized water solution for cleaning conductivity probe
- Clip Boards (3)
- Pens/Pencils
- Field Journal
- Waders (not included in case; pick up your size when you pick up the case)

Materials needed:

- Oranges for measuring rate of flow.

StreamTeam

Water Quality Monitoring

Water Quality Testing Procedures
Discharge, Dissolved Oxygen (Oxygen 2), Nitrate, Phosphate, pH, Temperature, Conductivity

Table of Contents

SETUP PROCEDURES

1. Remove cover and wetting cap from the **pH** meter. Place pH electrode in the pH 7 buffer solution to soak for at least 10 minutes. You may collect samples as electrode is soaking.
2. Fill out site information on the **Field Data Sheet.**
3. Using the thermometer inside of the blue case, take the air temperature measurement.
4. Follow the testing procedures in order.

TESTING PROCEDURES

I. DISCHARGE (RATE OF FLOW)

1. The stream length chosen for the measurement of rate of flow should be straight (no bends), at least 6 inches deep, and should not contain an area of slow water such as a pool.
2. Measure a 20 foot length of stream you will study. Mark the beginning and end of the segment with a stick or stone. Record length on the Field Data Sheet.
3. Use the tape measure to measure stream width, and stake ends on each bank. Keep the tape measure in this position to identify where you will take stream depth measurements.
4. Using the yard stick, take stream depth measurements at ¼, ½, and ¾ way across the stream. Record stream width and depths and calculate and record the average stream depth on the Field Data Sheet.
5. One person releases an orange in the fastest part of the stream 20 feet upstream of the stream segment. Another person stands at the downstream and uses the stop watch to measure the time it takes for the orange to float the 20 foot stream length. Another person scoops the orange out of the water. This "time of travel" measurement should be conducted **three (3) times** and recorded on the Field Data Sheet. Calculate the average time of travel.
6. Calculate discharge and record on the Field Data Sheet.

II. COLLECTING WATER SAMPLES

Grab Sample for Dissolved Oxygen

A **grab sample** is a sample of water collected at one point in the stream.

1. Carefully wade into the fastest part of the stream.
2. Rinse the sample bottle three times with stream water, emptying the water downstream of you.
3. Submerge the sample bottle completely, and allow water to flow into it for 2 minutes to ensure that no air bubbles are trapped inside the sample bottle. Cap bottle while it is submerged under water.

Composite Sample for Nitrate, Phosphate, pH, and Conductivity

A **composite sample** is a sample of water collected across the width of a stream at appropriate frequencies based upon stream width.

1. Carefully wade into the stream.
2. Rinse the sample bottle three times with creek water, emptying the water downstream. Be sure to fill the sample bottle upstream of you so that you are not collecting sediment disturbed by your feet.
3. At ¼ way across the stream, fill 1/3 of the sample bottle gradually, avoiding any turbulence (which would add oxygen to the sample).
4. Repeat this step ½ way across the stream.
5. At ¾ way across the stream, fill the rest of the bottle with water. Cap the bottle under water.

III. MEASURING DISSOLVED OXYGEN, NITRATE AND PHOPHATE

1. **FOR ALL PARTICPANTS' SAFETY, WHEN WORKING WITH CHEMICALS** each participant using and/or observing close to equipment must wear **safety goggles and gloves.**
2. Photometer is in the blue case. All three test kits also belong in this case.
3. Turn on the photometer by pressing the **(power)** key.
4. Remove all dirt and fingerprints from the ampoule before inserting in photometer.
5. Make sure the ampoule is seated properly all the way down.
6. Always cover the ampoule with the ***light shield*** prior to zeroing the instrument, setting a reagent blank value, or measuring a sample.

Dissolved Oxygen

1. Press the **(prgm)** key; enter **Program number 141: Oxygen 2.**
2. Using a paper towel, remove all dirt and fingerprints from the zeroing ampoule.
3. Insert the zeroing ampoule into the photometer with the white line on the ampoule facing the key pad. Cover the zeroing ampoule with the ***light shield***, and press the **(zero)** key. **"WAIT"** is displayed until the result is displayed as **"0.000".**
4. Fill the sample cup to the **25 mL** mark with the DO sample.
5. Place the Vacu-vial ampoule against the side of the cup. Snap the tip by pressing the ampoule down against the side of the cup. The ampoule will fill, leaving a small bubble to facilitate mixing.
6. Mix the contents of the ampoule by inverting several times, allowing the bubble to travel from end to end each time. ***BE CARFUL NOT TO PLACE FINGER ON TIP OF AMPOULE, TIP WILL BE VERY SHARP.*** Using a paper towel, wipe all liquid from exterior of the ampoule.
7. Insert the resulting test ampoule in the photometer. Cover the test ampoule with the ***light shield.***
8. Press **(meas)** key. Color development wait time is specified in the parameter specific test procedure. Color development for DO will take **2 minutes**. The photometer timer will begin countdown and automatically proceed to the measure mode when wait time is complete. The instrument will read the test ampoule and display the test result.
9. Record the test result on the Field Data Sheet.
10. Place used ampoule and chemicals in the WASTE bottle.

Nitrate

1. Press the **(prgm)** key; enter the **Program number 119: Nitrate.**
2. Using a paper towel , remove all dirt and fingerprints from the zeroing ampoule
3. Insert the zeroing ampoule into the photometer; cover the zeroing ampoule with the light shield and press the **(zero)** key. "**WAIT**" is displayed until the result is displayed as"**0.000**".
4. Fill the **reaction tube** (small bottle with lime green lid) to the **15 mL** mark with Nitrate sample.
5. Empty the contents of **one (1) cadmium foil pack** into the reaction tube. Cap the reaction tube and shake vigorously for ***exactly 3 minutes***. Allow sample to sit undisturbed for ***2 minutes.***
6. Pour **10 mL** of the sample into the sample cup, being careful not to transfer any cadmium particles to the **sample cup**.
7. Place the Vacu-vial ampoule against the side of the cup. Snap the tip by pressing the ampoule down against the side of the cup. The ampoule will fill, leaving a small bubble to facilitate mixing.
8. Mix the contents of the ampoule by inverting several times, allowing the bubble to travel from end to end each time. ***BE CARFUL NOT TO PLACE FINGER ON TIP OF AMPOULE, TIP WILL BE VERY SHARP.*** Using a paper towel, wipe all liquid from exterior of the ampoule.

9. Insert the resulting test ampoule in the photometer. Cover the test ampoule with the ***light shield.***
10. Press (**meas)** key. Color development for Nitrate will take **10 minutes**. The photometer timer will begin to countdown, and automatically proceed to the measure mode when wait time is complete. The instrument will read the test ampoule and display the test result.
11. Record the test result on the Field Data Sheet.
12. Place used ampoule and chemicals in the WASTE bottle.

Phosphate

1. Press the **(prgm)** key; enter the **Program number 159: Phosphate 2.**
2. Using a paper towel, remove all dirt and fingerprints from the zeroing ampoule.
3. Insert the zeroing ampoule into the photometer; cover the zeroing ampoule with the ***light shield***, and press the **(zero)** key." **WAIT**" is displayed until the result is displayed as "**0.000**".
4. Fill the sample cup to the **25 mL** mark with the sample.
5. Add **2 drops** of **A-8500 Activator Solution**. Cap the sample cup and shake it to mix the contents well.
6. Place the Vacu-vial ampoule against the side of the cup. Snap the tip by pressing the ampoule down against the side of the cup. The ampoule will fill, leaving a small bubble to facilitate mixing.
7. Mix the contents of the ampoule by inverting several times, allowing the bubble to travel from end to end each time. ***BE CARFUL NOT TO PLACE FINGER ON TIP OF AMPOULE, TIP WILL BE VERY SHARP.*** Using a paper towel, wipe all liquid from exterior of the ampoule.
8. Insert the resulting test ampoule in the photometer. Cover the test ampoule with the ***light shield.***
9. Press (**meas)** key. Color development for Phosphate will take **3 minutes**. Photometer timer will begin to countdown, and will automatically proceed to the measure mode when wait time is complete. The instrument will read the test ampoule and display the test result.
10. Record the test result on the Field Data Sheet.
11. Place used ampoule and chemicals in the WASTE bottle.

Troubleshooting the V-2000

- If the V-2000 Photometer gives an error message, produces a suspect test result or in any way malfunctions, see directions for the Self-test in Section 2-9 of the V-2000 Photometer Operator's Manual.
- If battery dies, please see instructions in V-2000 Photometer Operator's Manual, Chapter 1: **Battery Installation**.
- If you have to insert the adaptor: The tabs on the adaptor (left and right sides) should be matched up with the alignment slots to the left and right of the sample cell compartment. Insert the adapter with the correct alignment and push down firmly until it snaps into place. Disregard the lock-unlock feature on the ampoule cell compartment. Do not attempt to turn the adaptor from left to right when inserting or removing it.

IV. pH, TEMPERATURE AND CONDUCTIVITY

pH and TEMPERATURE

1. Remove the pH probe from the electrode storage solution. Pour used electrode storage solution into the waste bottle.
2. pH meter should have been soaking for at least 10 minutes (see Setup Procedures). If not, soak it in the pH 7 buffer solution for 10 minutes.
3. Follow the procedures under "Composite Sample" to collect a composite sample for pH, Temperature and Conductivity tests.
4. Rinse pH and temp probes with deionized water using DI squirt bottle.
5. Calibrate probe using **pH 7 *and* pH 10 buffers** following steps 10 – 17.
6. Pour **10 mL of pH 7 in the bottle marked pH 7.**
7. Power on the meter and it automatically enters into measurement mode. Select pH mode by pressing mode key, if necessary.
8. Dip both pH electrode and temperature probe into **pH 7.00** buffer solution. Swirl gently and wait for reading to stabilize (approx. 30 seconds depending on your electrode condition).
9. Press **CAL** key to enter pH calibration mode. A **"CA"** displays momentarily and the display shows the current uncalibrated reading flashing while in the calibration mode.
10. To abort or cancel calibration without accepting new value, press **CAL** key. The meter then reverts to pH measurement mode.
11. To proceed with calibration, allow reading to stabilize. The meter automatically recognizes pH 4.01, 7.00, or 10.01 buffers. Press **ENTER** key to confirm calibration and LCD displays **"CO"** momentarily. The meter reverts to *measurement* mode.
12. For 2 point calibration, repeat with pH **10.01** buffer. See steps 13 – 16.
13. Rinse pH electrode and temperature probe with deionized water using DI squirt bottle.
14. Pour **10 mL** of **pH 10** in the bottle marked **pH 10.**
15. Dip both pH electrode and temperature probe into pH 10.01 buffer solution. Swirl gently and wait for reading to stabilize (approx. 30 seconds depending on your electrode condition).
16. Press **CAL** key to enter pH calibration mode. A **"CA"** displays momentarily and the display shows the current uncalibrated reading flashing while in the calibration mode.
17. Record calibration readings for pH 7 and 10 buffer test result on the **Calibration readings: 7pH buffer**/ **10 pH buffer** line on the Field Data Sheet.
18. Rinse pH electrode, temperature probe, and both small bottles with deionized water using DI squirt bottle. Pour used buffer solutions and wastewater into the waste bottle.
19. Power on the meter and it automatically enters into measurement mode. Select pH mode by pressing mode key if necessary.
20. Dip both pH electrode and temperature probe into test sample. Swirl gently and wait for reading to stabilize (approx. 30 seconds depending on your electrode condition). **Take readings until same endpoint is reached twice in a row.**
21. Record the pH and temperature test results on the **pH / Temperature (°C)** line on the Field Data Sheet.
22. Rinse pH electrode and temperature probe with deionized water.
23. When finished with pH and temperature measurement, refill wetting cap with new electrode storage solution and replace on end of pH probe.

When not in use, the pH probe should always have the wetting cap with electrode storage covering the tip. FAILURE TO REPLACE WETTING CAP WILL RESULT IN PERMANENT DAMAGE TO THE pH electrode.

CONDUCTIVITY

1. Conductivity is measured in **µS/cm (**microSiemens per centimeter) with Extech ExStik II meter. Calibrate the conductivity probe using **1413 µS/cm conductivity standard solution**. Follow steps 2 – 7 below. Calibration should always be done in *conductivity* mode.
2. Rinse electrode with deionized water and dry with Kimwipe.
3. Fill plastic sample cup with 20 mL 1413 µS/cm conductivity standard solution.
4. Turn the meter **ON** and insert the electrode into the standard solution. Tap or move the electrode in the solution to dislodge any air bubbles.
5. Press and hold the **CAL/RECALL** button (approximately 2 seconds) until **"CAL"** appears in the lower (temp) display. The main display will start flashing.
6. The meter will automatically recognize and calibrate to the standardizing solution. The display will briefly indicate **"SA",** end then return to the measurement mode after calibration.
7. The "range calibrated" symbol will appear in the display for the range calibrated, in this case, **M** for medium range, 1413 µS/cm.
8. Record calibration on the Field Data Sheet.
9. Rinse electrode with deionized water and dry with Kimwipe. Pour used solution into the waste bottle.
10. Depress and hold the **MODE/HOLD** key to scroll to the desired measurement mode.
11. Insert the electrode into the sample making sure that the electrodes are completely submerged. Tap or move the electrode in the sample to dislodge any air bubbles.
12. The meter will auto-range to the proper range and then display the reading. Take readings until same endpoint is reached ***twice in a row***.
13. Record the test result on the **Conductivity: ________ µS/cm** line on the Field Data Sheet.
14. Rinse electrode with deionized water and dry with Kimwipe. Pour out sample water.
15. When finished with conductivity measurements, rinse conductivity probe with **50/50 alcohol/deionized water solution** by placing in solution and stirring for a few seconds. Dry with a Kimwipe.
16. Replace protective cover over meter and store meter in the black hard case with the pH meter.

V. CLEAN UP

- Carefully replace all equipment and sample bottles in carrying case. Empty all sample bottles. Rinse with deionized water and empty. Leave lids off sample bottles in fabric carrying case so bottles can dry.

- Make sure all solution bottle lids are on tight. Replace all calibrating solutions in their ziplock bags.

- Tightly seal top of WASTE bottle.

- Place all sample bottles in carrying case and pack all equipment in clear container.

- Complete any notes on the Field Data Sheet.

- Double check site for any remaining equipment, sample bottles, lids, trash, etc.

Updated 4/01/08

Stream Team Water Quality Terminology
Provided by Sheila Murphy – USGS and basin.org

Water quality parameters provide important information about the health of a water body. These parameters are used to find out if the quality of water is good enough for drinking water, recreation, irrigation, and aquatic life. But what do the parameters really mean? How are they measured? What natural and man-made factors affect them? This page provides a brief summary of what each water quality parameter means. For more information, visit www.basin.org.

Conductivity (Specific Conductance) is a measure of how well water can pass an electrical current. It is an indirect measure of the presence of inorganic dissolved solids, such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron. These substances conduct electricity because they are negatively or positively charged when dissolved in water. The concentration of dissolved solids, or the conductivity, is affected by the bedrock and soil in the watershed. It is also affected by human influences. For example, agricultural runoff can raise conductivity because of the presence of phosphate and nitrate.

Dissolved Oxygen (DO) is the amount of oxygen dissolved in the water. DO is a very important indicator of a water body's ability to support aquatic life. Fish "breathe" by absorbing dissolved oxygen through their gills. Oxygen enters the water by absorption directly from the atmosphere or by aquatic plant and algae photosynthesis. Oxygen is removed from the water by respiration and decomposition of organic matter. The amount of DO in water depends on several factors, including temperature (the colder the water, the more oxygen can be dissolved); the volume and velocity of water flowing in the water body; and the amount of organisms using oxygen for respiration. Human activities that affect DO levels include the removal of riparian vegetation, runoff from roads, and sewage discharge.

Flow is the volume of water moving past a point in a unit of time. Two things make up flow: the volume of water in the stream, and the velocity of the water moving past a given point. Flow affects the concentration of dissolved oxygen, natural substances, and pollutants in a water body. Flow is measured in units of **cubic feet per second (cfs).**

Nitrogen is required by all organisms for the basic processes of life to make proteins, to grow, and to reproduce. Nitrogen is very common and found in many forms in the environment. Inorganic forms include **nitrate (NO_3)**, **nitrite (NO_2)** , **ammonia (NH_3)**, and **nitrogen gas (N_2)** . Organic nitrogen is found in the cells of all living things and is a component of proteins, peptides, and amino acids. Excessive concentrations of **nitrate**, nitrite, or ammonia can be harmful to humans and wildlife. High levels of nitrate, along with **phosphate**, can overstimulate the growth of aquatic plants and algae, resulting in high dissolved oxygen consumption, causing death of fish and other aquatic organisms. This process is called ***eutrophication***. Nitrate, nitrite, and ammonia enter waterways from lawn fertilizer run-off, leaking septic tanks, animal wastes, industrial waste waters, sanitary landfills and discharges from car exhausts.

pH measures hydrogen concentration in water and is presented on a scale from 0 to 14. A solution with a pH value of 7 is neutral; a solution with a pH value less than 7 is acidic; a solution with a pH value greater than 7 is basic. Natural waters usually have a pH between 6 and 8.5. The scale is negatively logarithmic, so each whole number (reading downward) is ten times the preceding one (for example, pH 5.5 is 100 times as acidic as pH 7.5). The pH of natural waters can be made acidic or basic by human activities such as acid mine drainage and emissions from coal-burning power plants and heavy automobile traffic.

Phosphate: Phosphorus is a nutrient required by all organisms for the basic processes of life. Phosphorus is a natural element found in rocks, soils and organic material. Its concentrations in clean waters is generally very low; however, phosphorus is used extensively in fertilizer and other chemicals, so it can be found in higher concentrations in areas of human activity. Phosphorus is generally found as **phosphate** (PO_4^{-3}). High levels of phosphate, along with **nitrate**, can overstimulate the growth of aquatic plants and algae, resulting in high dissolved oxygen consumption, causing death of fish and other aquatic organisms. The primary sources of phosphates to surface water are detergents, fertilizers, and natural mineral deposits.

Temperature of water is a very important factor for aquatic life. It controls the rate of metabolic and reproductive activities. Most aquatic organisms are "cold-blooded," which means they can not control their own body temperatures. Their body temperatures become the temperature of the water around them. Cold-blooded organisms are adapted to a specific temperature range. If water temperatures vary too much, metabolic activities can malfunction. Temperature also affects the concentration of dissolved oxygen and can influence the activity of bacteria in a water body.